RAILROAD GAZETTE

SATURDAY, OCTOBER 5, 1872.

Contributions.

On the Physical Characteristics of the Missouri River, and the Means used for Directing and Controlling its Channel at St. Joseph, Mo.

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[A paper read before the Civil Engineers' Club of the Northwest, September 10, 1872.]

When the headwaters of the Missouri River pass the city of St. Joseph, they have traveled 2,500 miles, and are increased by all the streams flowing down the eastern slope of the Rocky Mountains between the thirty-ninth and fiftieth parallels of north latitude.

The river at that point is the drainage of 413,000 square miles of water-shed, upon which there is an annual rain-fall of 19½ inches.

The mean elevation of its surface is stated by "Humphreys and Abbott" to be 760 feet above tide water, and it has about 480 miles further to go before joining the Upper Mississippi, near Alton, where it is 331 feet above the level of the sea. Fourteen hundred miles above St. Joseph, Captain Reynolds found the surface to be 2,194 feet above tide water.

Its average slope, therefore, for about nineteen hundred miles, is ninety-six one-hundredths of a foot per mile; but the slope is not exactly uniform. Between eight hundred and a thousand miles above St. Joseph, it is one and one-tenth feet; between four hundred and six hundred miles above, it is one foot; and from St. Joseph to the Mississippi River it is seventy-nine one-hundredths of a foot per mile.

A careful survey for seven miles in the vicinity of St. Joseph, and observations for a year, show an average slope of eighty-two one-hundredths of a foot per mile. The difference between the slopes of the river at these different points is so slight, compared with the great distances between them, that for any work of a local character the engineer may consider the average slope, as he finds it at any point above the confluence of the Mississippi and below Fort Union, to be a constant quantity, and hereafter in speaking of the river, I would be understood as referring to it in the vicinity of St. Joseph.

The distance between the bluffs of the Missouri in the vicinity of St. Joseph is from four to six miles. They are generally rocky, composed of nearly horizontal strata of limestone, sandstone, soapstone and drift, and covered with a marl concretion sometimes called loess, supposed by some geologists to be identical with the loess bluffs of the Rhine upon which grow the famous vineyards. There are sometimes breaks in this rocky formation; the city of St. Joseph is built in one about four miles wide; but the bluff is continuous, and a gap between the rock formation is generally filled with loess like that which caps the bluffs above and below. During the present geological and meteorological condition of the country, the wanderings of of the river cannot extend beyond the bluffs.

The valley between these boundaries is an alluvial plain, through which the river cuts its way from bluff to bluff, making eight complete crossings in a distance of thirty miles measured in the direction of its general course. These windings of the river leave tongues of land alternately reaching from one bluff to within a few thousand feet of the other. Inhabitants of the towns built opposite the point of one of these tongues of land have usually a constant fear lest some flood may cut through the base of the peninsula, letting the channel run along the opposite bluff, thereby leaving them miles inland. Such cases have occurred within the last few years: one at Forest City, about twenty-five miles above, and one at Hamburg, near Nebraska City. These fears have a depressing influence upon any public work depending for success upon the permanency of the bottom lands. The citizens of St. Joseph are not without their fears; and, although I do not say it is impossible that a cut-off should occur opposite the city, yet its improbability is so great that for all practical purposes it may be considered impossible, and should the danger of a cut-off appear at any time imminent the engineer can avert it.

Without maps a particular description of the river and its windings may be necessary to an understanding of the matter; and here I may explain that all elevations given refer to a datum line assumed one hundred feet below the surface of the flood of 1844, the highest known to civilized man. This line is assumed to be 676 feet above the sea.*

St. Joseph is built upon the east side of the river valley, partly on the loess bluff and partly on the clay bottom lands, the largest part of which is above the reach of the highest floods. Beginning three miles above the town, the river leaves a rocky bluff on the east side and runs nearly west across the valley to the rocky bluff at Belmont; thence, with a sharp curve, it returns to a loess bluff in the upper part of the town, called Prospect Hill; thence, with an easy curve to the south, with a radius of about 7,000 feet, it *now* flows along the clay bank in front of the town for about three miles, when, having acquired a due west course, it crosses the valley again and strikes the bluff above Palermo, about three and a half miles south of Belmont. Thus the river has flowed about eighteen miles to accomplish seven of its general course.

The channel at low water, which we find to be 80, is from three to five hundred feet wide, of very unequal depth, ranging from five to twenty-five feet, with an average sectional area of eighteen hundred feet, and a mean velocity of two and four-tenths miles per hour. The exceedingly irregular character of the low-water channel makes all measurements of this kind at such a time very unsatisfactory.

The following measurements were made under favorable circumstances, and I rely upon their correctness:

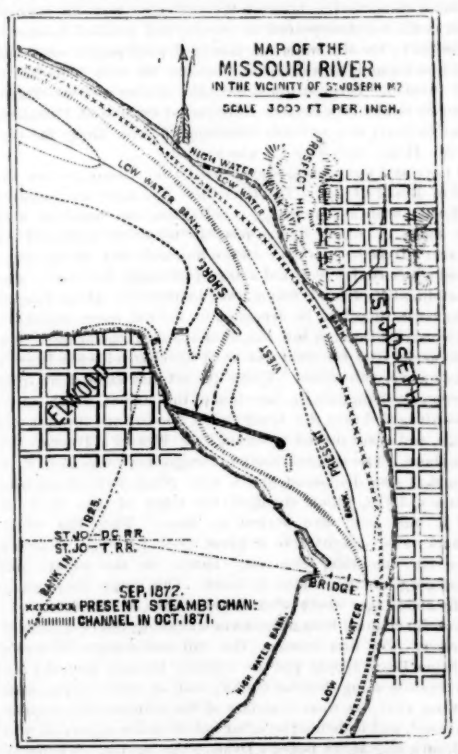
At 86, the sectional area was 13,126 square feet; mean velocity, two and sixth-tenths per hour; discharge per second, 40,690 cubic feet. At 92, the height of ordinary floods, the sectional area is 25,450 square feet; mean velocity, three and seventy-five one-hundredths miles per hour; discharge per second, 139,975 cubic feet. At 92 the river is from fifteen hundred to thirty-five hundred feet wide between its proper banks. When it subsides, it leaves these banks distinct; but the space between them is nearly filled with sandbars.

The river at low water does not materially encroach upon the high-water banks; but, first cutting its way through the lower bars, around accumulations of driftwood and the higher bars, it makes a channel which crosses the high-water channel from bank to bank every two or three miles. It then begins cutting away the higher bars, depositing lower ones along its own channel, and conducting itself, on a smaller scale, as did the larger river before it. Sometimes it cuts its way through the base of a high bar and makes a new channel against the bank opposite to that along which it ran a few hours before, leaving the point of the bar an island.

The bottom lands appear to me to have been built up in three different periods of time, each period depositing different materials, and under different circumstances from either of the others.

Let us suppose the present time to belong to the third period. In the second period, the river at average flood was from two to three miles wide and had an average elevation of 100. Its highest floods must have reached 120; its low-water channel was similar to the medium high-water of to-day.

In the first period, great floods filled the valley and the river scoured its rocky bed with boulders weighing tons. Its low-



water channel was greater than the highest floods of to-day. Its deposits were boulders, gravel, coarse sand and clay. The high clay bottoms which exist to-day have this deposit for their source. The deposits of the second period were of fine sand and clay, and are of great fertility. They are covered, when not cultivated, with a heavy growth of timber, principally sycamore, oak and elm, and some of the trees are of great size. The deposits were made in the low-water channel of the first period. Their elevation is from 100 to 110.

The deposits of the third period are silt and fine sand, having in them but a trace of clay and organic matter. The silt and sand weigh from 61 to 86 pounds per cubic foot when dry and loose, and from 74 to 97 dry and packed. If not disturbed, in a few years they become covered with a thick growth of weeds, cottonwood and willows. They are known as "cottonwood bottoms." A fact explaining the growth in height of the newer bottoms in some places is, that sand and silt brought from the newer bars during the winter and spring months by the winds are deposited among the weeds and brush. A new bottom within two miles of St. Joseph has grown five feet in many places within the last year from this cause. The elevation of these bottoms is from 94 to 100.

Now, the low water of to-day has very little effect upon the deposits of the second period, and the high water of to-day, equal to the low water of the second period, has small effect upon the deposits of the first. The low water of to-day is continually cutting away and changing the form of the high-water deposits, and the high water of to-day is annually disintegrating and destroying the deposits of the second period. The low water of the first period sometimes cut through the base of bars, making islands. In the second period, whichever side of the island the river ran, the opposite channel was filled with its deposits; and it is through these deposits that a cut-off is possible for the floods of to-day.

The wanderings of the river of to-day are bounded, therefore, so far as cut-offs are concerned, by the deposits of the first period.

In the tongue of land opposite St. Joseph, at the east end of which the west abutment of the bridge now building across the Missouri River is placed, is a spine of this material extending from the rock bluffs at Wathena, between Belmont and Palermo, to within a mile and a half of the city. Evidences of struggles and failures of the river in the second period to cut off this point are apparent in the direction of a steep bluff of the first deposits, five to eight feet high, dividing this from the second formation.

The land composing the tongue north of this spine is almost wholly of the second formation; while around the east end and along the south side both the second and third are generally found. Although the general direction of the river bends may be considered fixed, yet among the lighter clay and sand of the second and the light sand of the third deposits, occupying the low-water channel of the old river, seldom less than two and often three or four miles wide, the river wanders at will, and no spot therein can be considered a safe foundation for an enduring structure without artificial protection from its encroachments. To give such protection to the west approach to the bridge, and to insure the passage of the channel of the river through the draw at all times, were the ends sought to be gained by building dykes and shore protection last winter.

The bridge now building over the Missouri River at St. Joseph is located about a mile and a quarter below Prospect Hill, nearly in the center of the long bend in front of the city, and the embankment forming its west approach will rest for three-fourths of a mile upon a part of the third deposit. At that distance from the river the approach reaches the first formation. Every part of this space has been occupied by the river within the past fifty years. At the time the location of the bridge was made, the channel of the river turned directly south from a point 1,200 feet west from Prospect Hill, and ran thence south to within half a mile of the bridge, at which point it impinged upon the Kansas shore; thence easterly, parallel with the bridge about 3,500 feet to the clay bank forming the east shore, leaving a bar a mile long and 2,000 feet wide, at an average elevation of 90, in front of the city; thence turning directly south, it formed the lower part of the long bend above referred to.

The preliminary surveys for this work were made in February, 1871. The succeeding flood in June and July was small, enduring above 90 but eighteen days, and touching 93 only a few hours; but the action of the river on its west bank showed that in five years it would cut through the deposits of the last fifty years and reach its old westerly shore, lengthening the bar in front of the city two miles, and leaving the bridge half a mile from its eastern beach.

The problem was to stop the river where it was then running, and drive it three thousand feet east and through the bar and against the clay bank, which was its eastern shore ten years ago. Work was begun for this purpose in October last, and by the 1st of August following all of our objects were accomplished.

The manner in which this work was done and the means used were as follows:

From a point on the west shore, three thousand feet southwesterly from Prospect Hill, a dyke was projected into the river at right angles with the current as it then ran, and continued in a right line eighteen hundred feet. This dyke inclines down stream somewhat from a line at right angles with the general direction of the high-water channel as corrected, the upper angle being about 70 deg. It is called "Beard's Dyke."

Again, from a point on the west shore, 800 feet above the bridge and 3,200 feet along the shore below Beard's Dyke, another dyke was built starting at an angle of 45 deg. with the shore line and inclining down stream, until at a distance of a hundred feet from the bridge it has an angle of 45 deg. with the general direction of the river, and is 1,100 feet from the east shore. This dyke is 1,200 feet long, and is called "Weaver's Dyke." The point where it leaves the shore is immediately above the point where the channel impinged upon the bank when returning, after having been turned aside by Beard's Dyke half built; and except in one particular, which I shall hereafter mention, I am satisfied with the location of both dykes.

The woodwork of Beard's Dyke is from sixty to seventy feet wide at the base, thirty feet wide at the top and from twelve to thirty-six feet deep. The lower side is vertical. This woodwork is surmounted with a wall of rip-rap averaging twelve feet wide and three feet high, placed three feet from the lower edge of the woodwork. The whole was built to the average height of the bar on the opposite side of the river.

It was known by extensive soundings that, along the site of the dyke, the bed rock had an elevation of from 35 to 40, and that on the top of the rock was a layer of boulders from five to seven feet thick, covered with a stratum of stiff clay from four to five feet thick; thence to bottom of channel were the light sands of the river bed. The top of the clay is about 35 feet below the surface at low water. I am sure, from observations made while sinking the caissons for the piers of the bridge, that the river never scours through this layer of clay, although water soundings show that it often reaches it. Weaver's Dyke was built of like materials to Beard's Dyke, and over a similar foundation; but only to 82, except the one hundred and fifty feet nearest shore, which is built to 96. It was designed that this dyke should stop the action of the low-water channel and resist the efforts of the next flood to cut a deep channel on the west side of the river, after it should have been deflected to the west by the bar, as it surely would be after passing the east end of Beard's Dyke; yet the dyke was left low so that too great an obstruction would not be offered at once, should an unusually high flood occur.

Beard's Dyke was put and kept in position in the water while building by first driving cottonwood piles about ten feet apart, within a space thirty feet wide along the lower half of the line

* Vide "Humphrey and Abbott."

of the proposed dyke. The piles were driven from ten to fifteen feet into the sand, left about three feet above water, and then sharpened at the upper end so that they should not afford a foundation for the brush and timber to be put between and upon them. Then young cottonwood and sycamore trees, from sixty to seventy feet long, untrimmed, were laid in parallel with the current, tops up stream, until the mass touched bottom, when finer brush was laid on, and sand carted on from the shore sufficient to make a double road for teams. This road of sand effectually packed and weighted the whole mass, and was kept high enough to allow the passage of horses and carts above the piles.

The first channel crossed was five hundred feet wide, and when the work was begun, sixteen feet deep, with a velocity in the centre of four miles per hour, and no sloughs debouched from it on the east side for a distance of two thousand feet above. When about half way across, the dyke obstructed the channel sufficiently to cause a difference of level in the water above and below it of three-tenths of a foot, and the increased velocity of the current consequent thereon enabled it to scour the bottom to a depth of 26 feet. The river also commenced cutting into the bar opposite, with a fair prospect of doing so as fast as we could build in so deep and rapid a current. It showed me, however, that the dyke once down offered a greater resistance to the current than did the sand bars, and I permitted myself to have no doubts of final success on account of its failure thereafter. The channel we were attempting to cross was the principal one of three, separated by islands of sand bars; the middle one was about seven hundred feet wide, but too shallow to be navigated by the ferry-boat at low water, and the last one was a mere slough about three hundred feet wide, and was fast filling up.

About two thousand feet above the dyke the west channel separated from the others. At that point it was about eight hundred feet wide and six or seven feet at its deepest. A dyke of a temporary character was built across its head, which turned nearly all its waters into the other channels, and greatly lessened the current of the main work, so much so that the washing away of the bar ahead of us ceased.

This temporary work was built of willow brush, laid between small piles driven with a wooden maul, and weighted with a road of sand. It was about fourteen feet wide and eight hundred feet long, with its top about a foot above water. Before it was completed the channel scoured the bottom in some places to a depth of from ten to eleven feet. In ten days' time it changed the navigable channel to the middle one and remained intact until the breaking up of the ice in February following, when about half of it was torn loose and floated away. A bar with its surface at 89 now covers the remainder. Until after a rise of two feet in November, which nearly filled the channel behind it with sand, it withstood the pressure of a head of water four-tenths of a foot high.

After this dyke had succeeded in turning the channel, Beard's Dyke was completed in the manner in which it was begun, and across the channel to an island about four hundred feet wide, with a surface at 82. Over the island, which was but a sandbar, the dyke was built without piles. Upon reaching the river again, the dyke behind us was built to 88, the riprap wall put on, and a sand road made upon it by which to bring forward material. The river was now frozen over and the current quite sluggish. The middle channel was crossed with the dyke without having to work in a greater depth than fourteen feet. A narrow bar between the middle and east channels, two feet under water, was reached, and the east end of the dyke was finished by building a mole about one hundred feet in diameter at the bottom. This was built by driving eighty piles within the limit of its base, and piling up between and upon them brush with the tops outward, in layers alternating with riprap, to the height of the dyke. The layers of brush were about four feet thick, and of riprap two. Upon the top of this work a mound of riprap was built to 93. Although the river has scoured to a depth of 35 feet on the upper and east sides of the mole, its total settlement since completion is less than six inches. By the time this work was completed, a deep channel, 490 feet wide, had cut through the east channel or slough before mentioned, and had for its east shore the wide bar in front of the town. It was deflected by the bar to the west, and, reaching across the old channel, struck Weaver's Dyke nearly at right angles at a point but a few feet from the shore end. Weaver's Dyke, built in the same manner as Beard's Dyke, of piles, brush, sand and riprap, had for its principal object the affording of resistance to this expected attack of the river upon the west shore. The dykes were built in the form and manner described, upon the hypothesis that should an impinging current scour the bottom and undermine the front of the dyke, the front part would settle and sink down until the lowest limit of scour was reached, the back part remaining without material change of elevation. The front of Weaver's Dyke was built in from ten to fifteen feet of water. When the channel from the end of Beard's Dyke struck it, as before mentioned, it began scouring and letting down the front as expected. The point of impingement of the current gradually passed down stream along the face of the dyke, and before the ice broke up the whole front of the dyke had reached a depth averaging eighteen feet below low water.

These dykes were finished about the middle of February. The river was then frozen over with ice from twelve to sixteen inches thick, with a surface at 82½. The ice showed signs of breaking up about the 20th of February, and on the 23d it started, the river suddenly rising to 87. This soon cut a channel 650 feet wide opposite the east end of Beard's Dyke.

The channel appeared a river of rolling ice, scarcely any water being visible. Large masses were forced against and entirely over Beard's Dyke, without injuring the wall of stone or moving any part of it. Weaver's Dyke being low, much ice escaped over it in from four to five feet of water.

On the twenty-fourth a gorge of ice formed about four hundred feet below the east end of Beard's Dyke, extending from the east shore of the river to Weaver's Dyke. The gorge dammed the river until it stood three feet higher above it than *at* the bridge, distant about half a mile below. The gorge broke first at Weaver's Dyke, and in a few minutes the channel was scoured to such a depth that it remained from thirty to thirty-four feet deep along the face of the dyke after the ice was gone and soundings could be made, with the river at 84. The dyke settled down in front with the scour—turned over, so to speak—but the wall of riprap remained at nearly the same height and in the line where it was built. Beard's Dyke across the middle channel settled about two feet. This is probably as severe a test of the ability of this form of dyke to resist and turn aside the river as could be afforded under any circumstances.

About the first of June, this year, the spring flood had reached 90, almost entirely submerging the great bar, and flowing over Beard's Dyke in a thin sheet, with a fall of from six to eleven inches. And now began in earnest the work of removing the bar and making a new channel along the clay bank of the east shore. To do this required the taking away of at least five million cubic yards of sand. This was accomplished by the middle of July, the flood averaging 93 meantime.

The effect of the obstruction to the current by Beard's Dyke at this height of the river was to make a lake of comparatively still water above it, extending to the current of the flood then running along the bar opposite Prospect Hill. Through this lake ran threads of current to supply the overflow of the dyke, strong enough to move sand along but not to scour. The dyke standing firm, this lake was a constant force pressing the current against the bar. This the current attacked first near Prospect Hill, by eating into it abruptly fifty to a hundred feet, forming what is called by river men a "pocket." The pocket once formed, it moved down stream, the current cutting away the bar as the mower cuts a swath, and in a few days would pass below the dyke and disappear. But before the first one had done its work the second and sometimes the third had begun, and were following swiftly after. Meanwhile sand was deposited along the line between the still water and the current, and as the bar disappeared the current still pressed against it, crowded by the still water, the line of deposit passed eastward, the new-formed bar widened and became the west boundary of the channel. This continued until the current met the resistance offered by breakwaters constructed by M. Jeff. Thompson thirteen years ago, and still remaining effective along the east bank. It was then where it was wanted.

I have said the pockets disappeared after passing below the end of Beard's Dyke. The river there was thirty-five hundred feet wide, while at the bridge it is but fourteen hundred, with the width in which it was possible to scour narrowed by Weaver's Dyke to less than eleven hundred, and in this space stood a pier twelve feet, and a draw-rest thirty feet wide. The great quantity of sand taken away by the river above Beard's Dyke must, therefore, be deposited in the still water behind it, or be carried through the narrower space at the bridge. For some weeks after the flood was at 93 the channel below Beard's Dyke was very uncertain. Every pocket that came down from above made changes in the direction of the current, which sometimes struggled over the lower end of the bar and through the bridge, and again rushed westward over Weaver's Dyke to the west shore. The amount of sand brought down was more than it could at once dispose of, and a sand gorge formed opposite Weaver's Dyke, which changed the slope of the river in half a mile from five inches to nine. Thus the whole channel was caught in a great pocket, with Weaver's Dyke on one side, the clay banks on the other, and a sand gorge at the bridge in front. This gorge disappeared wholly about four weeks after the formation of the great pocket, and the channel became uniform and along the east bank of the river. The line between the still water above Weaver's and below Beard's Dyke and the current became defined; the sand deposits along this line began; and, at this writing, with the water at 87, the west boundary of the channel is as regular as the east, and is defined by a bar out of water nearly all the way from a mile above Beard's Dyke to the bridge. Whenever the surface current was forced over Weaver's Dyke by the sand gorges in the channel, the direction taken approximated to a line at right angles with the dyke; therefore it impinged upon the west bank immediately in the rear of the dyke. The effect of this impingement was to to form whirlpools about two hundred feet in diameter between the dyke and the bank, the outer rim running at the rate of ten miles per hour, the vortex two to two and a half feet lower than the rim. These whirlpools often developed themselves fully in fifteen minutes from their beginning, and would cut away the bank at the rate of thirty feet in twenty minutes. They often became in half an hour so full of driftwood that the water was scarcely visible. Their action upon the bank was stopped by a revetment of trees, brush and riprap, followed by a double line of piles driven parallel with the shore and about a hundred feet from it. When the sand gorges in the channel gave way, these whirlpools ceased as quickly as they began, and the driftwood floated away down the river. Soundings taken over the space where they existed immediately after their disappearance, showed that they scoured to the surface of the clay stratum at an elevation of 45. The dyke remains as it was built. Had Weaver's Dyke been placed at right angles with the current, these whirlpools could not have formed: and in completing the system of dykes at the west approach, the bank of the approach will be made the high-water dyke, and a low-water dyke will be built to 82 directly along the bridge line, six hundred feet out from the west abutment, thereby leaving Weaver's Dyke to act simply as a revetment for the west shore above the bridge.

The influence of Beard's Dyke is such that for a mile above it, and west of a line parallel to the present channel and passing five hundred feet to the east of it, there is no channel with the water at 87 for a boat drawing three feet; while in many places, and particularly in the deepest of the channels obstructed by it, the sand has filled in forty feet deep, and now completely covers the dyke from sight. The surface of the new bar is in many places at 94. Below the dyke sand and mud have been deposited, so that with the river at 82 there will be a bar a mile and a half long and half a mile wide where flowed the river eight months ago.

The amount of deposits caused by this dyke during the flood of this summer is more than eight million cubic yards. The bulk of the dyke as it now stands is 56,000 cubic yards, of which 3,000 cubic yards are riprap, and the rest brush and trees, with the interstices filled with sand. Its cost, including engineering and superintendence, was $32,600, and it was built in four months' time.

Weaver's Dyke was built at right angles to the line it was expected the current would take after being disturbed by Beard's Dyke, and for the purpose of resisting the current until Beard's Dyke should have caused the channel to run along the east shore, and entirely away from it. Had it been built perpendicular to the channel at the time it was commenced, it would have failed to protect the shore, as the new channel would have run parellel with it. It was not expected that one flood would accomplish all that was desired, but the extraordinary duration of the flood this summer—about 90 for ten weeks—enabled the river to do as much as was expected of it in two ordinary seasons. I think more water has passed this summer than during the great flood of 1844, which, although six feet higher than the river has been this year, was of short duration. The water now averages four feet above that at the same time in any year of which we have any record; and it is still so high above low water that the whole effect of the works cannot be seen with the eye, but is only known by careful soundings.

I have endeavored in this paper to state as briefly as possible the purpose for which the works were built, the surrounding circumstances, and the results already attained; and although in my own mind I am satisfied that our success is complete, I purposely avoid suggesting theories or drawing conclusions until the present flood shall have subsided and shown exactly what has been accomplished.

September 1, 1872.

PRACTICAL FIELD ENGINEERING.

NO. VII.

ESTIMATING EARTHWORK.

For the sake of convenience I shall discuss the subject of estimating the earthwork of railroads under three heads, viz.:

1. GENERAL ESTIMATES, made for the purpose of convenience for reference in letting contracts, and calculating the probable cost of building the road.

2. MONTHLY ESTIMATES, made each month by the field engineer in order to ascertain the amount due the contractors for work done.

3. FINAL ESTIMATES, made after all the work is completed by the contractors and accepted by the engineer.

And first let us examine the best methods of calculating the cubic contents of earthwork.

Where all the sides of a body are parallel, the superficial area of a right cross-section multiplied by the length of the body will give the cubic contents of the body. Thus if with a level grade you have a cutting in ground whose surface is level, to find the cubic contents of the excavation you have only to find the superficial area in feet or yards of a cross-section, and multiply this area by the length of the cut in feet or yards. But, since in practice it generally happens that not only are the grade line and the ground surface *not* parallel, but the ground surface laterally sloping, it has been necessary to look for a rule adapted to the solution of this latter case, and mathematicians have long since rigidly demonstrated the accuracy and utility, for this purpose, of the

PRISMOIDAL FORMULA,

which has been thus enunciated:

1. Take a cross-section at each end of the prismoid (which in this case is a cutting or embankment) and one at the middle of the same. Then, *to the sum of the two end areas add four times the middle area and multiply the result by one-sixth of the length of the prismoid.*

To find the area of any cross-section the following rule is sufficiently accurate:

2. Add together the side-cuttings (or the side-fillings, as the case may be), and multiply the sum by half the breadth of the roadway, and set aside the product. Then multiply the *product* of the side-cuttings (or side-fillings) by the ratio of the side-slopes to unity, and add the result to the product already set aside. Result will be the cross-sectional area.

To make this important rule plain let us take an example:

Suppose the sum of the side-cuttings or side-fillings to be 20 feet, and one-half the breadth of the roadway to be 8 feet. Then $20 \times 8 = 160$, the product to be set aside. Then suppose the *product* of the side-cuttings is 75 feet, and the ratio of the sides-slopes to unity $1\frac{1}{2}$ to 1. Then, $75 \times 1\frac{1}{2} = 112.5$. Then, $160 + 112.5 = 272.5$, the area of cross-section.

The *prismoidal formula* and the rule last given are presented for use in cases where the method below explained cannot be applied.

The best practical method of preparing estimate sheets will now be carefully explained, and first for general or preliminary estimates.

CALCULATING THE CROSS-AVERAGE.

3. To the sum of the side depths add twice the center depth of the cutting or embankment and divide by 4. The result will be the average depth of the cross-section. This is called the cross-average.

CALCULATING THE LENGTH-AVERAGE.

4. Divide the sum of two consecutive cross-averages by 2; quotient will be the length-average depth of the prismoid.

CALCULATING THE CUBIC CONTENTS.

The cubic contents of railroad earthwork are generally ex-

pressed in yards. A cubic yard is, therefore, taken as the unit of expression.

The following rule is simple and accurate, giving results entirely satisfactory where the lateral slope of the ground surface has not been so irregular that the rules for ascertaining the cross and length-averages could not be safely applied:

5. *Rule for Finding Cubic Contents of a Prismoid.*—To the breadth of the roadway add the depth (length-average) of the cut or fill multiplied by the ratio of the side-slopes to unity; multiply the product by the depth (length-average) of the cut or fill, and multiply this result by the length of the prismoid and divide the final product by 27, if your measurements have been in feet. Result will be the contents of the prismoid in cubic yards.

Where the engineer has a reliable table of the squares of numbers, say from 1 to 1,000, the following is the shortest rule for finding the cross-sectional area:

6. Add the depth of the cut or fill (the cross-average) to half the breadth of the roadway. From the square of this sum subtract the square of half the breadth of the roadway. Result will be cross-sectional area.

Where the lateral slope of the ground surface is broken and irregular, the levels for cross-section must be so taken as to show these lateral undulations, and the areas must be calculated by dividing the cross-sections into triangles. This done, the prismoidal formula must be applied in calculating the cubic contents.

For estimate-sheets, rule large-sized foolscap paper into five columns, headed as follows:

Station.	*Slope.*	*Length-average.*	*Excavation.*	*Embankment.*

Now, by the rules already given, calculate from your cross-section book the length-average between each two consecutive cross-sections, and place it in the proper column, opposite the second of the two cross-sections, as numbered in the column headed "station," and mark it + or —, according as the work is cut or fill. Place your slope ratio in the column headed "slope." Then by Rule 5 find the cubic yards of excavation or embankment contained between the first two cross-sections, and place the number in the proper column, and so on.

The above rules and illustrations will be sufficient to direct the young engineer in the matters to which they apply, and the next thing about which he will naturally inquire is how properly to prepare a monthly estimate, a subject touching which little is to be found in the pocket-books prepared for the profession. It is the general custom with railroad builders to pay their contractors once a month for all the work done during the month next preceding the settlement, less *ten per cent.*

Monthly estimates should be made with great care, though it must be admitted that most of our field engineers are in the habit of doing some "tall guessing" in the performance of this duty. You should go over the work carefully and measure the excavation and embankment, entering the dimensions of each in a convenient form in a small field-book, indicating finished work by some appropriate sign for your own information. This done, it is short work to ascertain with sufficient accuracy the cubic yards of work done, from which having subtracted *ten per cent.* your report is ready. The level should be used wherever a cut or fill cannot with rod and tape-line be measured with sufficient accuracy. A little practice and the exercise of a little judgment will soon teach the young engineer how to dispatch this duty rapidly and satisfactorily.

Final estimates are made after the earthwork has all been finished by the contractor and received by the engineer. This requires the highest degree of accuracy. Measurements should be made with great care of the top-width of cuts, the breadth of the roadway in both cutting and embankment, the dimensions of the side-ditches, of borrow-pits, and, in fact, everything that is an element in the contract for work. After these data have been gathered and from them an estimate of all the earthwork made, the sum of all the monthly estimates is subtracted therefrom, making due allowance for the deducted 10 per cent., and a final settlement is reached.

In the proper place, under the head "Superintending a Division," information will be given in some matters having important bearing, on the subject of estimates.

Concluding this paper it may be remarked, that no final estimate ought to be treated as of any value unless it is based on the most careful personal examinations and measurements of the engineer. The elements of an estimate vary with each contract, and in the hands of the field-engineer are placed the interests of both corporation and contractors. He should never swerve an inch from the direct line of his duties.

HOOSIER.

Railroad Accounts.

LOUISVILLE, September 25, 1872.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I notice in your issue of September 21 a communication by "Alpha," and an effort to excite to action the accounting officers of railroad companies in a direction that would undoubtedly result to the benefit of the companies. While I think it inexpedient to urge the acceptance of one system or routine, owing to the diversity of the scope of accounting officers, I am of the opinion that a uniform classification of the operating expenses, mileage of engines and cars, etc., such as may be agreed upon and accepted, will materially assist managers in their comparison of the operations of other lines, and call attention to points where better results are exhibited. As it is now, comparison can be made in general matters only, and details of operations which are subject to retrenchment are, by reason of their obscurity, of but little value as criterions. In so simple a statement as a "locomotive exhibit" no uniformity prevails, in which is generally stated "miles run to ton of coal," leaving it optional to the reader to presume either the long or short ton. Why not adopt the "pounds consumed per mile run" used by the Pennsylvania Railroad, which is certainly clearer than any other method now in use, or adopt a standard ton, and let its weight be known and accepted by all parties as the basis of their calculation? Also in the "cost per mile for oil and waste" some include oil used for every purpose, others only the lubricating, and thus information by which economy can be stimulated, in seeing how other roads are doing, is rendered useless by this want of uniformity. If the accounting officers will make no effort in this direction, I would suggest that the Master Mechanics' Association take this matter in hand, and I hope that they will exclude head-light and signal oil, giving each an equal showing in the application of lubricants, avoiding the unjust discrimination and inability of fair comparison by reason of night trains incident to all roads but unequal as to extent.

I wish to add one more requisite to those named by "Alpha," viz., the adaptation or arrangement of accounts in their details to furnish information upon matters where further economy may be exercised. I may be able to explain better by the following illustration: Some roads in making tabulated statements of the locomotive performance show the cost of engineering, firing, watching and cleaning of each engine. It may, no doubt, be pleasing to set a great array of figures; but what economy can be effected in glancing over this statement? The fact that a certain engine has cost more per mile run for engineering and firing than another (due to being assigned to freight or work-train duty) is no indication that a reduction is possible. Now I consider a statement for the round-house, showing the value of small stores issued to each engine, of more value than the first named; in the latter waste can be checked, in the first no check is required. The cost per mile run of the aggregate is, after all, accepted as the result and used for comparison with other lines.

I hope that steps will be taken to form an association as named by "Alpha" (an annual meeting and interchange of opinions, with the experiences of the year, will certainly benefit all), and that the subject will be further discussed in your valuable paper by others, and that in this manner the outlines of an association may be sketched. If it is charged by the other departments that we are "earning no money," I think we are entitled to equal credit for "taking care of the same." I trust that on this subject I shall not be,

OMEGA.

Fireless Locomotives.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your correspondent "Practical Engineer," September 14, inquires how much useful steam can be drawn from 132 cubic feet—8,250 lbs.—of water, at 366°, there being no loss from radiation.

The pressure at 230° is 5½ lbs. above the atmosphere; and I assume this to be the lowest pressure that can be of any use; that the train will stop when the pressure has fallen to this point.

The total heat of steam at 366° is	1,221.2°
The total heat of steam at 230° is	1,182.2°
The mean total heat is	1,201.7°
From which deduct	230
And there remain	971.7°

or, say, 972°; which is the average quantity required to vaporize one pound of water, under these conditions.

The difference between 366° and 230° is 136°, which multiplied by 8,250, the number of pounds of water, gives the total number of units of heat exhausted in lowering the temperature. This number is 1,158,720. Dividing this by 972, the number of units required to make one pound of steam under these conditions, we get 1,192, which is the number of pounds of water turned into steam.

The mean pressure of this steam, above the atmosphere, will be about 73 lbs. per inch. Under very favorable conditions as to grades and curves and load, we may assume this pressure as effective as the usual even pressure; and I will so assume it, for the sake of making the case as favorable as possible for the system we are considering.

Passenger engines in this region burn from 25 lbs. of Cumberland to 30 lbs. of anthracite coal per mile. Let us suppose that they use 200 lbs. of water per mile. Dividing 1,192 by 200, we get 5.96 miles as the distance that may be run by a locomotive with 132 cubic feet of water at 366°, supposing no heat to be lost.

The case might be more favorable if the temperature were raised to 386° and the pressure to 196 lbs.; but it is inexpedient now to speculate on this point.

I believe this system has been tried in an experimental way, probably under unfavorable conditions, and without capital to make the trials thorough and to combat difficulties as they arose. The results I have not heard of. But I imagine there would be much priming, when steam is evolved from hot water as gas is evolved from soda water. And I would not, as a speculation, undertake to make dry steam in this way. But I would not say that the subject is not a proper one for the hazard of underground railway companies and others who need a motor that will not contaminate the air.

The Metropolitan Underground Railway engines work partly on this system; they drive their fires in the cuttings, and run up their pressure to 130 lbs.; and shut their dampers on entering the tunnels, and emerge with 70 lbs. pressure. They exhaust into condensers when in the tunnels. As to their priming, I have heard nothing. But I have reliable information that their boilers require much more repairing than any others, to keep them tight. But this fact has been denied by the managers. And there have been, and are now, charges of concealment and deception against this company, sufficient to warrant great distrust of the reports that their system works economically.

So far as I am informed, the practice of running the pressure up and down, and pumping irregularly, or in any way altering the temperature to much extent and frequently, causes leakage, and soon renders extensive repairs necessary to a locomotive boiler. But a simple cylinder, such as your correspondent proposes, is a very different thing, and may bear such treatment.

The question of discharging the warm water and refilling with hot water is one of some difficulty, which I suppose your correspondent reserves until he is satisfied as to whether power can be got for a useful distance. The change of water must be made in 45 seconds to be useful on underground lines. I see by the daily papers that this system is now at work near New Orleans, and that they somehow "compress" the steam into the water, instead of changing the water.

A simple cylinder will cost much less than a boiler, and will allow a better arrangement of axles and springs; and probably the repairs of such an engine will cost very little compared with one of the Metropolitan class.

J. K. FISHER.

No. 30 BROADWAY, New York.

Russian Medals of Honor.

NEW YORK, September 28, 1872.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Some days since I saw paraded in the columns of *Engineering* a letter from Count Bobrinskoy to Mr. Fairlie, acknowledging the great services he rendered the Livny Railway of Russia, and sending him a medal. I send you a copy of a similar letter sent to Capt. C. P. Sandberg, who also received one of the medals, and no doubt deserved it as well as any other person connected with that railway, as he was the Engineer-Inspector in England for that railway. He has won for himself, by his ability, care and great integrity in the matter of rails, their make and inspection, a world-wide reputation, as is well known by many of the leading railway men of the United States, who now submit the whole of their inspections to him, knowing that what he undertakes will be well done. Captain Sandberg's modesty has prevented his sending a copy of this complimentary letter to *Engineering*, to be "trotted out" before the public, I, not having the same modesty, send it to you for publication.

W. W. EVANS.

The following is a copy of the letter from Count Bobrinskoy to Mr. Sandberg. It is dated St. Petersburg, June 1872:

"His Majesty the Emperor, my master, has authorized me to have a medal stamped in commemoration of the construction of the Imperial Livny Narrow-gauge Railway, which medal is to be distributed to the persons who have taken an active part in the construction of the line.

"Acting as Inspector for the Imperial Government, you took the greatest care that the rails and their accessories furnished for the Livny Railway were of the best quality; therefore it is with great pleasure that I hereby forward to you one of the medals, to which you have an indisputable right."

Mr. Fairlie has sent us a copy of the letter from Count Bobrinskoy accompanying his medal to which Mr. Evans refers above. The substance we have given heretofore. We subjoin it in full:

"His Majesty the Emperor, my master, has authorized me to have a medal stamped in commemoration of the construction of the Imperial Livny Narrow-gauge Railway, which medal is to be distributed to the persons who have taken an active part in the construction of the line.

"The success of the Livny Railway is in a large measure owing to your system of engines, and to your careful inspection; therefore it is a great pleasure for me to forward to you herewith one of the medals which you have so well deserved."

TRAFFIC AND EARNINGS.

—The earnings of the Erie Railway for the week ending September 23 were: 1872, $473,353; 1871, $483,102; decrease, $9,749, or 2 per cent. The earnings for the 23 weeks from April 1 to September 23 were: 1872, $9,172,754; 1871, $9,160,745; increase, $12,009, or ¼ per cent.

—The earnings of the Baltimore & Ohio Railroad, main stem and branches, for the month of August were: 1872, $1,253,976; 1871, $1,147,242; increase, $106,734, or 9¼ per cent. The earnings of the Washington Branch show an increase of about $2,500, notwithstanding the opening of the Baltimore & Potomac road.

—The earnings of the St. Louis & Southeastern Railway (consolidated) for the third week in September were $25,700, being an increase of $500 over the corresponding week in August.

—The receipts of wheat at St. Louis from the various railroad lines east of the Mississippi, for the week ending September 21, were as follows:

	Bushels.
Ohio & Mississippi	19,950
Chicago & Alton	10,850
Indianapolis & St. Louis	27,300
Vandalia Line	24,500
Belleville & Southern Illinois	8,750
Rockford, Rock Island & St. Louis	6,300
Toledo, Wabash & Western	12,950
St. Louis & Southeastern	51,547
Total	162,147

—The earnings of the Burlington, Cedar Rapids & Minnesota Railroad for the month of September were $118,010.68.

—The earnings of the St. Louis & Iron Mountain Railroad for the second week in September were: 1872: $50,364; 1871, $35,490; increase, $14,874, or 41¾ per cent.

—The earnings of the St. Louis, Kansas City & Northern Railway for the third week in September were: 1872, $56,449; 1871, $48,349; increase, $8,100, or 16¾ per cent.

—The earnings of the St. Louis, Alton & Terre Haute Railroad, main line, for the third week in September were: 1872, $34,762; 1871, $32,658; increase, $2,104, or 6½ per cent.

The earnings of the Toledo, Wabash & Western Railway for the third week in September were: 1872, $147,978; 1871, $123,872; increase, $24,106, or 19½ per cent.

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Editorial Announcements.

Correspondence.—*We cordially invite the co-operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.*

Inventions.—*No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.*

Articles.—*We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

NEW RAILROADS AND NATIONAL WEALTH.

A few weeks ago we copied a strking article from the *Nation* on this subject, and made some comments and criticism. The article of the *Nation* was very widely copied, and has elicited many replies, some of which have been ignorant and indignant, while others showed some knowledge of the facts. The carefully-edited *Commercial and Financial Chronicle* has treated the subject with some elaboration, and comes to the conclusion that we are not building too many railroads, and "that the danger for some years will be, not in our making too many railroads, but in our bad location of them, in dishonest management, in the tricks, combinations and concentrated power of speculators and other improper men who get into places of trust."

While we felt called upon to dissent from some of the positions of the *Nation*, we think the *Commercial and Financial Chronicle* makes a greater mistake in the opposite direction. In the first place, it makes a new issue, and strives to show that the construction of so many railroads is a benefit to the country; while the *Nation's* argument was rather to the effect that the securities of so many new companies might not be altogether safe. So far as the latter matter is concerned, the effect of railroads in promoting business and increasing the value of real estate is not to be taken into account. The only question is, can so many new roads find traffic enough at rates which they can maintain to produce the net earnings necessary to meet their obligations? And it will not do even to count on the effect which the railroad may have in increasing production in four or five years, resulting finally in increased traffic and earnings. The interest on bonds cannot be put off for four or five years, but must be met yearly. It is usual to reserve sufficient to meet two or three coupons; but thereafter most roads must pay the interest on their debts from their net earnings.

We have before tried to make it plain that roads with a moderate bonded debt will be able to meet their interest charges with very light earnings. That there are not some new roads whose interest charges are likely to be greater than their net earnings, we will not say; we fear there are, and that we will hear from them in no very long time—lines which will share the fate of the Rockford, Rock Island & St. Louis, and find it very hard to earn their working expenses. We hope, however, that there will not be many such, and if the crowding of lines together in sections already well supplied is not continued, we may continue so to hope. But it is absolutely certain that if we continue to construct in certain districts three or four times as many railroads as are needed to do the business, *some of them must fail.*

The *Chronicle* quotes some one's estimate that the increase in the wealth of a country caused by the construction of a railroad is ten times the cost of the railroad. This is called a rough estimate; but it is not an estimate at all, but only a wild guess. Indeed, the effect of a railroad may vary infinitely, from a positive detriment—which is not at all impossible—to the creation (or rather utilization) of value where none was possible before. That is, before we can make any estimate of the effect of a railroad on a country, we must first know the circumstances of the country. When a railroad is constructed into a country previously without facilities for transportation near enough to make the products of that district profitable, its effect on values is enormous. Indeed, but for the known possibility and probability of the construction of a railroad, there would before have been scarcely any values in that country. Now it is a railroad in a district like this which serves as the example from which the rule is deduced that the average railroad increases the value of property in its vicinity to an amount equal to ten times its own cost. But the average railroad in these days is not such a road. Indeed, it would not be easy to find a place in this country where all production is unprofitable. And by far the largest number of railroads constructed of late years have not been in districts where production was unprofitable. Most have been in districts already well provided with railroads, where the lines previously in operation had not one-fourth—not one-tenth—of the traffic they could be made to convey, and—what is most important—where no very considerable increase of products of the soil will result from any possible increase of railroads.

And, where profitable railroads may be constructed, the benefits to the community are often comparatively light. Two parallel lines being thirty miles apart, and the intervening country being generally occupied and largely utilized, a third railroad half way between the two may earn a good profit on its cost. But in such a case the new railroad would be rather a convenience than a great economy to the people, and the measure of the economy would depend chiefly on the nature of their produce. If this were chiefly cotton or wool, the cost of hauling to the station would be hardly felt. If it were cattle, the difference in distance would be, perhaps, less important; if hogs, something more so; if wheat, the week spent in hauling might be reduced to three days; if corn, the time saved would probably be three times as much as in the case of wheat. And the time thus saved would be nearly the whole of the *economical* advantage. It is true that the increase in the price of the lands would probably be out of proportion to this saving in time, especially in the case of farms within three or four miles of stations. But most of this increase in price is paid, not on account of the increased capacity of the farm as a producer of wealth, but because of other advantages which have no relation to production—chiefly social advantages. The farmer and his family find life pleasanter in such a place, and they pay more for it than for one fifteen miles from a station, though they make and expect to make little or no more money on it. The entire belt of thirty miles wide produces and exports little more than it would have done had there been no new railroad; there is a considerable addition to travel; and the traffic, quite profitable, it may be, of the new railroad, is chiefly made up of what the old roads would have carried had the new one not been constructed.

There are hundreds of such cases in this country, and they would be obvious enough if most parts of the country were not progressing so rapidly that what an old road loses to a rival has generally been made up immediately by an increase in through, if not in local traffic. The growth of traffic has not been caused by the new railroad alongside of it, but by the new settlements and new railroads in the country beyond it.

We do not feel called upon to defend the *Nation*, especially as that journal is abundantly able to defend itself; but that part of the *Chronicle's* article which would prove our railroads profitable because they are more so than the English railroads deserves attention. The English railroads have earned an average profit on the capital invested varying from 3.31 to 5.48 per cent. for the past thirty years, and on an average about 4¼ per cent. To quote this as an example of a profitable investment seems to us extraordinary. In England 5 per cent. is reckoned a fair profit in an enterprise whose returns are regular and reasonably certain. But the returns of British railroads have been anything but certain and regular. Millions on millions have been utterly lost; very few companies, indeed, give a large return, and the last year, which was the most productive since 1847, gave an average profit of only 4.52 per cent. We would say positively that the British railroad system has offered "blanks and few prizes to its investors." The system, indeed, seems to us more valuable as a warning than as an example. It shows many of the worst faults of reckless competition and overbuilding. The investors have been disappointed, and the country has not been profited as it would have been with fewer lines. With the enormous traffic of so populous a country, fares are higher that in our own comparatively thinly-peopled country, and freights, we believe, also. In some of the countries of the Continent, where the lines were proportioned more exactly to the work they had to do, the cost of transportation is very much less than in England, while at the same time the companies make much larger profits.

We have shown before that the price of property is often increased by new railroads when its productive value is unchanged by it. Doubtless in this way new roads add to the country's wealth when there is no increase of traffic by them. But estimating only the effect of railroads on the productive power of the country, we will find it to vary in almost every individual case, and in many cases to be very small, as well as very large in many. In many parts of Texas cattle only can be produced profitably, and these are driven hundreds of miles to market. It is reasonable to believe that a railroad within a day's drive of the pasture would increase the value of these cattle in Texas; but even this is denied by men—railroad men, too—who have studied the subject, who say that the slow driving northward in the summer is as profitable pasturing as the herding of the cattle on the Texas prairies. This is an example of the modifying circumstances which must be taken into account. But by a railroad a region where grazing only had been profitable may be able to grow grain advantageously. Here the measure of the profit to the country is not the difference between the values of the grain before and after the construction of the railroad, but the excess in the profit of grain-growing with the railroad over the profit of grazing without the railroad. And so in hundreds and thousands of instances, we must know all the circumstances affecting production before we can say, even approximately, what the value of a railroad will be to any particular district. Northern Texas now produces chiefly cotton for export. It can produce cheaply corn and wheat, for which there is a constant demand at good prices on the Gulf and on the Lower Mississippi. But it produces very little grain, except near the navigable portion of the Red River, to supply this demand, the cost of transportion is so great; but cotton rather, though the latter goes very much further than the grain. But an acre of corn may weigh two thousand pounds, while an acre of cotton will weigh probably not more than two hundred. We may say that a railroad to the Gulf will revolutionize agriculture in Northern Texas, and make planting there much more profitable than it is now, taking as a basis for our estimates the current prices of grain near the Gulf. But if we find that four or five fertile counties in Northern Texas will be able to supply the entire demand in the lower counties, we will see that our calculations need further revision; that on the whole but a small portion of the Northern counties can be given to producing grain; that the capacity for production in the North is so much greater than the capacity for consumption in the South that there is more likely to be a great decrease in the price in the South than a great increase in the profit of grain-growing in the North; that cotton, for which the demand is practically unlimited (so far as the capacity of Texas to produce is concerned) must remain the chief product of the northern counties, while grain growing must be subsidiary.

We do not give these as positive facts in this particular case, but as examples of the kind of facts which are likely to present themselves for consideration in estimating the traffic and the effect on production of a railroad in a country nearly destitute of facilities for transportation. They will often be very numerous and very complicated, especially where a mineral traffic may be developed. In all cases they should be subjected to severe scrutiny and careful calculation before a line is undertaken where there can be any question as to its profitableness.

Trials of Road Locomotives.

Two six-horse road locomotives, belonging to the Telford Pavement Company, were tried at South Orange, N. J., on the 1st inst. by Prof. R. H. Thurston, of the Stevens Institute of Technology, to ascertain their power in ordinary work.

The engines are by Aveling & Porter, and are alike, except that the wrought-iron driving-wheels, which have oblique projecting strips riveted on with snap-headed rivets to dig into the road and give adhesion, had been removed from one of them, and broad, smooth cast-iron wheels had been substituted, to serve as rollers. These cast-iron wheels added 6,700 lbs. to the weight, making the total weight of this engine 18,348 lbs Each engine has one cylinder, 7¼in. in diameter and 10in. stroke, geared to make 17 turns to one turn of the driving-

wheels, which are 66in. in diameter. The boilers have each 130 feet of heating surface. The wrought-iron-driver engine is new, and its boiler not yet clean, and it primed so much as to render it less efficient than that of its companion, which has been long at work, and did not prime.

Early in the day, we were informed, one of these engines drew 16 tons (wagons included) up a grade of one in 10. There were no slipping of the wheels in any of the trials, so we could not well judge as to the need of rough tires. The heaviest load drawn was by the smooth-tired engine, 56,000 lbs., up a grade of 250 feet per mile, at 3.6 miles per hour, the pressure falling from 103 to 90 lbs. in going 1,400 feet. The train consisted of 10 wagons, loaded with broken stones. Three horses to a wagon are used at this grade. The engine, therefore, drew the load of 30 horses, at a much higher speed than horses can draw such loads.

The road has a newly-made broken-stone surface, on a Telford foundation. Having been rolled, the surface must be in a first-rate order; but it was dirty to such a degree as to make it much more resistant than an English road that is swept. But this makes the test more practical for our use, for we shall not soon incur the cost of cleaning roads outside of cities.

The costs could not be determined in a short time, but some of the employees of the company thought it as low as a fourth of the cost of horse-power.

The engines are handier than horses. One man does all the work on an engine. With a train made to turn in the track of the engine, one additional man can manage the train. Thus two men can do the work of ten men with horses.

The quantity of fuel used had not been ascertained when we came away. But all reports concur in showing that the fuel costs very much less than horse feed.

The work was all done easily, without the least stoppage or delay. We saw no trouble with horses, though many were passing, and the steam blast was very loud when going up the grade; but Prof. Thurston said that some horses had shied, but were easily led past the train. Generally horses do not take fright; and the few that do, at first, soon become reconciled.

We saw nothing to excite a doubt of the general opinion of the company's employees, that the engines are much more economical and convenient than horses.

Record of Track Increase.

In this number of the RAILROAD GAZETTE information is given of the construction of the following sections of new railroad:

Ashtabula, Youngstown & Pittsburgh, extended from New Lyme southward 13 miles to Bloomfield, Ohio. *Missouri, Iowa & Nebraska*, extended from Lancaster, Mo., westward four miles to a junction with the St. Louis, Kansas & Northern Railway at Griffin. *Ionia, Stanton & Northern*, track laid from Ionia northward to Wood's Corners, Mich., 6 miles. *Detroit & Bay City*, extended from Orion north 3 miles to Oxford, Mich. *Lake Ontario Shore*, extended from Fairhaven westward 5 miles to Red Creek. *East St. Louis, Cahokia & Falling Springs*, completed from East St. Louis, Ill., southward down the Mississippi to a point opposite Carondelet, Mo., 7 miles, with a branch from Cahokia southwest 4½ miles to Falling Springs—in all 11½ miles. *St. Louis & Keokuk* completed from Hannibal south to New London, Mo., 9 miles. *Brownsville & Nodaway Valley*, completed from its junction with the Burlington & Missouri River Railroad at Villisca, Iowa, southward 15 miles to Clarinda. *Syracuse & Chenango Valley*, extended southeast about 9 miles to Erieville, N. Y. *Burlington, Cedar Rapids & Minnesota—Milwaukee Extension*, extended from Clermont southwest 13 miles to West Union, Iowa. *Marietta & Pittsburgh*, extended from Caldwell northward 23 miles to Cambridge, Ohio. *Sioux City & St. Paul*, completed by its extension southwestward 30 miles to a junction with the Dubuque & Sioux City line at LeMars, Iowa.

This is a total of 141½ miles of new railroad.

ENGLISH RAILROAD JOURNALS seem to have taken Erie under their wing, so to speak, ever since the revolution in the management last spring. Every new developement, every contract made or spoken of, and every new measure suggested is welcomed as an event of importance likely to bring the company out of all difficulties, and give dividends to the long-suffering holders of common stock. The recently reported arrangement with the New York, Boston & Montreal Company becomes the text for considerable editorials, in which the road is spoken of as lacking little of being a complete line from New York to Montreal, tapping "all the fine old New England States," and controlling 1,200 miles of railroad besides its own line of 350 miles. One would never think that all this is something hoped for, instead of an existing fact. The New York, Boston & Montreal has a few miles of road, and will be able to use some older roads when it has completed a connection with them, and doubtless will be able to send traffic over a great many hundred miles of railroad in New England and elsewhere as soon as it has made some connections. But if it is of any considerable value to Erie, it will be by connecting it with the existing system of New England roads, the manner of which is not explained, and not by opening it a route to Montreal or other points north of New York, connection with which would be of very little value to the Erie. Traffic will hardly go from Buffalo to Montreal or *vice versa* by way of New York.

CALIFORNIA WHEAT this year is so abundant that it is likely to largely increase the traffic of the railroads in that State. Four of the chief wheat-producing valleys are estimated to have produced about 21,500,000 bushels, or 685,000 tons; and as the produce of the rest of the State is doubtless more than sufficient for home consumption, all of this will be available for export, and nearly all will be moved some distance by rail. This is sufficient for 68,500 car-loads, or, in a level country, ,000 heavy trains, and probably most of it will be carried on three railroad lines to the bay of San Francisco. It might be manageable enough without any very large amount of rolling stock if it could be carried at any and all times of the year, as in the Mississippi valley. But the very favorable circumstances in California almost compel the shipping of the crop from the country within a few months after harvest. There being almost absolute certainty of dry weather for a few months after harvest, no provision is made by the farmer for sheltering the thrashed grain, and it is largely carried in open cars. Therefore, unless the railroads can transport the wheat before the wet season sets in, much of it is likely to be destroyed. An extra stock of cars to be used only a few months in the year is thus depended upon to take the place of the barns and granaries which are indispensable to the Eastern farmer.

The Mount Clare Shops of the Baltimore & Ohio Railroad.

Probably a very small proportion of our readers have any idea of the extent of the works at the Mount Clare shops, Baltimore, and it may cause some surprise when we tell them that 1,700 men are employed in and about the shops, and that the latter occupy forty acres of ground. Its form approximates a square, and one side fronts on West Pratt street. What was formerly the main line and entrance of this road into Baltimore bisects the square in a diagonal direction, and separates the shops into two groups. The general arrangement of them, like that of nearly all works of a similar character which have grown up with the business of the road to which they belong, is somewhat irregular, and is the result of a gradual growth, and not of any prearranged plan. In fact, they have been projected and designed by different men, and under the administration of different boards and executive officers. It must be remembered, too, that the Mount Clare shops were among the first railroad machine works built in the country, and that their history is coeval with that of American railroads. It is perhaps worthy of record that the first locomotive engine house built on this road, and probably the first built in the country, is now in course of demolition to make room for a larger shop which has been built over it. Several of the original turntables used in connection with this old shop are still to be seen around the works and are *eight feet in diameter*. The locomotives which were turned on these tables can also be seen at work about the yard, and are what are known as the "grasshopper" engines. They have vertical boilers and vertical cylinders, four wheels (all drivers), which are driven by a geared shaft. The pistons are connected to a sort of walking-beam or bell-crank overhead, the resemblance of which to the hind legs of a grasshopper gave the name to the engines. We have a lithograph of one of these engines, which we will have engraved, and then give some further description of their construction and operation.

Mr. John C. Davis is the Master of Machinery of the whole line of the Baltimore & Ohio Railroad, and Mr. Samuel Houston the Master Mechanic in charge of the Mount Clare shops. The office of Mr. Davis and the others connected with the Machinery Department are on Pratt street, in a two-story building 196 x 65 feet. The upper portion of this building is used as a pattern maker's shop, and for the general offices and drawing-room of the Machinery Department. The lower portion is used for the machine shop, in which the work—such as iron bridges, water-cranes, frogs and switches, track fastenings, etc., for the Road Department exclusively—is done. Mr. Wm. Primrose is the foreman of this shop. The power to drive the machinery of both this and the pattern shop is supplied by a very neat double-cylinder engine and locomotive boiler designed by Mr. Primrose. A railroad track runs through the centre of the building, so that cars or trucks can be run in to load or unload, or for moving the heavy work done there. Three large cranes also facilitate the handling of the heavy pieces of bridges and other similar work. The machinery consists of a large double-head lathe, which swings 9 feet in diameter and about 25 feet long. This is used for turning off the cast-iron towers and buttresses of the Bollman bridges which are used almost exclusively on this road. On turning the towers, a slide-rest with a tool-post is bolted to the face-plate. The former revolves with the face-plate, and the tool is fed inward, by an automatic feed, while the tower itself is stationary. There is also one single-head lathe 28 feet long for facing up the ends of the cast-iron bridge chords and posts. Besides these machines there is another lathe, which swings 40 inches diameter and 25 feet long, six smaller lathes, two planing machines 25 feet long by 3 feet 6 inches wide, one smaller planer, one shaping machine, nine drill presses for general work, five for bridge work and two multiple drills for drilling wrought-iron beams, three punching machines and eight screw-cutting machines. One of the latter will cut screws from 1½ to 3½ inches in diameter.

For testing bridge work, the shop is provided with a hydraulic testing machine, with a cylinder of 18 inches diameter and 24 inches stroke. This will bear a pressure of 600 lbs. per square inch, so that a bar can be subjected to a strain of over 150,000 lbs. A bar 60 feet long can be tested in this machine. All tension bars for bridges are tested with a strain of 15,000 lbs. per square inch before they are sent away from the shop.

All the work for the track of more than a thousand miles of road is done in this shop. At the present time, besides the ordinary work, Mr. Primrose has in progress three spans of double-track bridge for the Metropolitan Branch, where it crosses the Monocacy River near its junction with the Potomac. They are all 200-feet spans of "deck" bridges of the Bollman plan. The top chord is cast-iron, of octagonal section, 16 inches in diameter, and with a thickness of two inches of metal. The posts are 11-inch Phœnix columns. The buttress ends of the top chords weigh about seven tons. The track is carried on "box" floor-beams 24 inches by 12, made of cast channel iron for the top and wrought channel iron for the bottom, with wrought plates for the sides. The trusses are 30 feet in depth. All double-track bridges for this road are calculated to carry 8,000 lbs. per lineal foot, and the wrought iron with the maximum load is strained 10,000 lbs. per square inch.

The weight of one of these spans is as follows:

Cast Iron.....	277,598 lbs.	Chords, posts, etc.
Wrought Iron.....	251,559 "	Rods, pins, bolts, etc.
" " ...	45,080 "	Phœnix columns.
" "	5,683 "	" "
Steel.....	3,269 "	Post-pins and rollers.
Wrought Iron.....	2,581 "	Expansion plates.
" "	14,340 "	Channel bars.
" "	1,920 "	" "
" "	12,288 "	Boiler plate.
" "	1,732 "	" "
	616,000 "	

Besides this bridge they have another of 100 feet span for the Metropolitan Branch, and three spans for the South Branch (on the main line) of 139 feet. These are all double-track bridges. The last has trusses 18 feet deep, cast-iron octagonal top chords and posts, and box-beams. The chords are 12 inches in diameter, and the posts 8 inches. There is also another single-track bridge of 100 feet span for the Central Ohio Railroad, and one of 55 feet for the Parkersburg Branch.

In this connection, the following weights of a double-track Bollman through bridge may be interesting:

Cast Iron.....	167,541 lbs.	Chords, posts, etc.
"	57,564 "	Towers.
Wrought Iron.....	141,714 "	Rods, pins, etc.
" "	10,680 "	Plates for floor-beams.
" "	14,250 "	Channel plates.
" "	1,040 "	Rivets.
	392,789 "	

The span of this bridge is 160 feet.

To give an idea of the amount of work which has been done in this department, we found that over a hundred spans of bridges, varying from 75 to 200 feet span, and nearly all double-track bridges, have been built since the war, during which many of the bridges owned by this company were destroyed. The aggregate length of these is over two miles, or equivalent to four miles of single-track bridges. With the exception of seven spans which were built on the Fink system, they were all made on Bollman's plan, which is almost universally used on this road and its branches. Persons not familiar with these bridges can get a very good idea of their construction by referring to our sixth advertising page, which contains engravings representing the two systems very clearly.

PATTERN SHOP.

As we have already stated, the upper story of the building we have described is used as a pattern shop and offices. About 14 men are constantly employed in the pattern shop, under the supervision of Mr. Benjamin Burgess. The patterns are stored in a separate fire-proof building, built for that especial purpose. The care of the patterns for a road with so great a variety of machinery as is found on the Baltimore & Ohio Railroad requires much attention and systematic arrangement. Otherwise it would be impossible to find those needed when they are required. In this respect this shop is a model of order and careful arrangement. No naturalist ever classifies the genera and species of beasts and bugs more carefully than Mr. Burgess has arranged the patterns in the storehouse where they are housed.

We noticed in his shop several very neatly designed wood-turning lathes, intended the one for small work, the other for such as requires considerable room to swing. We regret not being able to illustrate these.

DRAWING ROOM.

This is under the care of Mr. David Holz, with several subordinates who work under his direction. The importance of having capable men in this department is, we regret to say, not appreciated on all roads as it should be. The Baltimore & Ohio road have always kept up this department in a thorough state of efficiency, and it is obvious that it has not deteriorated under its present management.

FOUNDRY.

The ground plan of this building is of the form of an L, and is 200 feet long and 60 wide on both the perpendicular and the base. It is under the charge of Mr. John N. Conway.

In the angle of the L is an iron house, 40x20. There are four cupolas, two for car-wheel work and two for soft castings. At present, from 50 to 60 tons of metal are melted and about 100 car-wheels are made per day. There are seven small wheel-cranes and three large 40-ton cranes for handling heavy work. The car-wheels are cooled in pits patented by Mr. Wm. J. Cochran, the former foreman of this foundry, but now one of the partners of the Baltimore Car-Wheel Company. These pits are sunk below the floor of the foundry, and are lined with boiler plate and hold 12 wheels each. A pipe three inches in diameter is connected with the bottom of them for ventilation. The tops are closed with cast-iron plates, and made air-tight, or nearly so, by placing a sheet-iron ring around the outside of the cover and filling it with sand. All, or nearly all, the heat must be carried off by the pipes referred to, and the temperature is changed very slowly and gradually, thus allowing the wheels to assume a fixed form without undue strain while cooling. The iron used in the manufacture of wheels is Chesapeake, Cedar Point, Locust Grove and Ellicott's—all brands of iron manufactured in Maryland.

The blast for the cupolas is supplied by one No. 6 Root blower, one No. 9 single, and one double Sturtevant, and one Mackenzie blower. The power is furnished by a 16x22 inch cylinder stationary engine.

The iron for wheels is first drawn into large ladles, which hold over 6,000 lbs. From these it is drawn into smaller ones, which hold enough for one wheel, and which are carried to the wheel flasks. The large ladles are mounted on wheels and a suitable track, and can be removed where they are required. Each cupola has two parallel tracks, which run up to its mouth, and the latter has a jointed spout, so that the stream of iron can be turned into the ladle on either track.

The portion of the foundry devoted to general castings is pro-

vided with a large core-oven, and much of the work is done in dry sand. Locomotive driving-wheels are all cast in dry sand, and it is said that much smoother castings are made in this way, which is a matter of more importance with driving-wheels than with most of the other castings used about locomotives.

BLACKSMITH SHOP.

The blacksmith shop is south of the foundry, and is 600 feet long by 70 wide. Mr. William Shipley is the presiding officer.

The shop is equipped with three 3,000-lb., one 2,000-lb., two 1,500-lb., one 1,000-lb., one 600 and one 500-lb. steam-hammers, all built by Bement, of Philadelphia. Steam is supplied to them by a large locomotive boiler. The shop has 85 forges and eight heating furnaces, two for blooming, two for axles, two for heavy forgings, such as locomotive frames, etc., and two for the rolling mill. The latter consists of one 14-inch two-high train of rolls, and one 8-inch three-high. In one of these round, flat and square iron is made, from ½x¼ inch to 7x1¼ inch. In the other, round iron from ¼ to 4½ inches diameter is made.

Besides the furnaces referred to, there are two for making springs, in which all the locomotive springs for the road are made and the car-springs repaired. The shop has 85 forges and employs about 350 men.

AXLE SHOP.

Adjoining the blacksmith shop is a two-story building, about 80 long by 60 wide, the lower story of which is devoted to the manufacture of bolts and nuts and finishing axles and wheels. Mr. John Goudy is the foreman. The bolts are all made by machines. Two of these are what are known as the Melville machines, and another Burdict's bolt-machine. The iron for the bolts is heated in two furnaces outside of the building, and the machines are located under a shed adjoining. On inquiring we found that the latter machine was pronounced the best, and was said to do the best work.

The axle shop contains one of Bement's largest punches for making nuts besides another double machine used for the same purpose, six axle-lathes, one cutting-off machine for axles, two wheel-boring machines, two screw wheel-presses, six bolt-cutters, four nut-tappers, and one shearing-machine for cutting off bolts.

The upper portion of the building is devoted to cabinet-making, such as office furniture, etc., of which there seems to be enough to keep a number of men constantly employed.

BOILER SHOP.

A new boiler shop, 390x76 feet, has just been erected and is now nearly completed. This has been built over the old engine house referred to above. The floor of this is quite novel and resembles somewhat the celebrated Nicolson pavement. It is made of wood blocks about six inches square and eight inches long, set on end and resting on a layer of compact sand. The blocks have none of the longitudinal pieces between them, which are used in the Nicolson pavement, but are placed against each other without anything between. This flooring has been used for a number of years in another building, and has been so satisfactory that it has been put down in the new boiler shop.

One large, one small, and one double punching machine, one shearing machine, one steam riveter, one plate planer, one suspension drill and a pair of bending rolls have been ordered for this shop.

The boiler-makers are under the charge of Mr. Moses Corprew. The boilers used on the freight engines for this road present some peculiarities. The top of the fire box and the crown sheets instead of being horizontal are inclined downwards from the flue-sheet towards the back end. Cross-wise they are arched in a segment of a circle. The two are then stayed with ordinary stay bolts, the same as the sides of fire-boxes. Many of our readers will remember a similar arrangement of the fire-boxes of Winans' engines, many of which are still in use. It is somewhat surprising, we think, that this plan has not come into more general use. It has the merit, first of greater strength, second of less weight, and third of giving a better circulation of water over the crown sheet, and would therefore admit of a larger boiler being used on a locomotive of any given weight. All the plates of the fire-box, excepting the flue sheet, are made of steel ¼ inch thick. The use of steel no thicker than ¼ inch has been very thoroughly tested on this road, where it has been in use nearly ten years with the most satisfactory results, which is strong evidence in favor of the economy and security of the system of staying crown-sheets with stay-bolts. It should be added that there are a number of engines on this road with ordinary straight-top boilers and flat crown sheets, which are stayed in the same way, and which have been at work now fifteen years or more and have given no trouble. Some of these were built by Mr. Hayes during his administration on this road, and others by Mr. Tyson. They have given less trouble than engines stayed with crown-bars, and we have not heard that any of these crown-sheets have given away, although our information on this point is not of a very positive character. In some cases nuts are screwed on the stay bolts underneath the crown-sheets. The bolts are ½-inch in diameter, and spaced four inches from centre to centre.

The outside shell of these boilers is made of ½-inch plates and all the seams are double-riveted with ½-inch rivets, which are spaced 2½ inches from centre to centre, and 1⅛ between the adjoining rows.

BRASS FOUNDRY.

A new building is now in process of construction for this purpose. At present the old one is located in that portion of the old engine-house which still remains. The new building is 105x50 feet and will give ample room. At present about 1,800 lbs. of brass are melted per day. Mr. James Henderson superintends this work.

In this foundry we observed what we have not seen elsewhere, that the driving-axle boxes, with the exception of the oil-cellars, are made of solid brass.

Adjoining the brass foundry is the grinding room, in which much of the bright finishing is done. In it there is one large fast-running grindstone, and two emery wheels. We regretted to observe that there was no provision here for carrying off the dust from the stone and emery wheels. The well-known unhealthfulness of this occupation, and the small expense of attaching some exhaust arrangement, leave a company without excuse for neglecting to make some such provisions for the health of those they employ.

MACHINE SHOP.

The principal machine shops at Mount Clare consists of two two-story buildings, about 200 feet long by 60 wide. These were originally built with a space of about 75 feet between them, which was afterward roofed over for an erecting shop. Mr. James Hodgson and Mr. Thomas Turner are the foremen of the lower floors of the machine shops.

The following is a list of the machinery and tools in their department: three large chuck lathes, three small roll-turning lathes, four small lathes for general work, two lathes for turning packing, one long lathe for shafting, one of about four feet swing, five horizontal boring mills for boring tires, three horizontal boring mills for driving boxes etc., two large planers for bed-plates and frames, one for cylinders, one for connecting rods, four about 18 feet long for general work, five radial drills, three cotter drills, thirteen drill presses, one 18-inch, three 12-inch and four 8-inch slotting machines, one car-wheel and one car-axle-bearing boring machine, two axle-lathes, one large double-head frame-slotting machine, one drill with traverse table for drilling frames, two machines for drilling bolt-holes in tires, three compound planers, one nut-facing machine, two vertical nut-tapping machines with seven taps each, one crank-pin lathe and eleven cranes for handling heavy work. Besides the above the following machines have been ordered: one double-head wheel lathe of 80 inches swing, one double-head lathe for packing, of 30 inches swing, one 38-inch lathe, two 24-inch, one 18-inch and one 16-inch, four planers with 9-feet bed, one of 18-feet bed about 60 inches wide, one compound planer and two 8-inch shaping machines. This, it must be remembered, includes only the heavy machinery on the lower floors, the smaller lathes and planers being up stairs.

The erecting shop, between the two machine shops, is used almost exclusively on new work. The whole available force is now employed on ten-wheeled freight locomotives, of which about four per month are completed. These locomotives would strike many of our readers as being very peculiar, but after long experience with them Mr. Davis was satisfied that they were the most economical engines in use on the road. Owing to the short curves on the line of the road it is impossible to run engines with a long wheel-base. The six driving

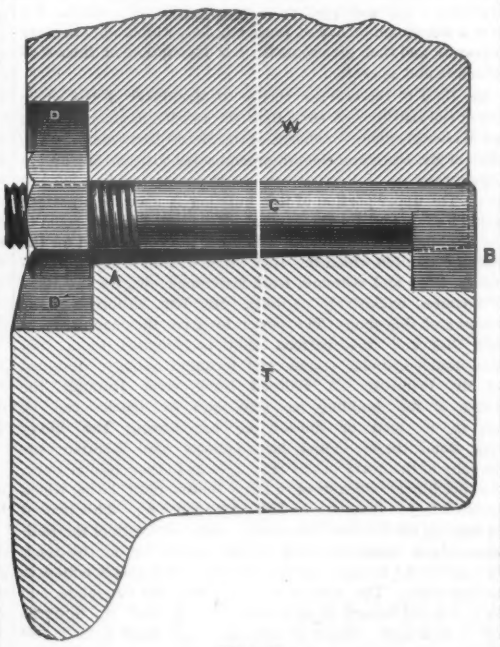

Fig. 1.

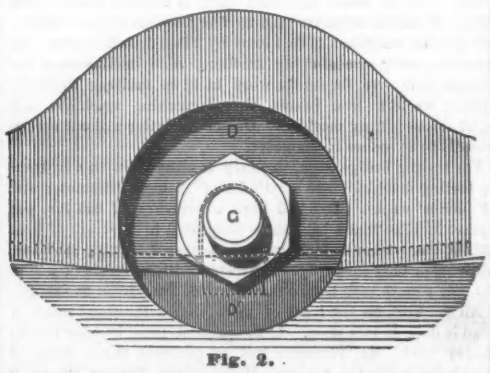

Fig. 2.

wheels are, therefore, all in *front* of the fire-box and as close together as it is practicable to place them. The cylinders are inclined at an angle of 6½ degrees with a horizontal line. The truck wheels are spread only 60 inches, thus enabling both the cylinders and trucks to be brought closer to the driving wheels. The latter are 50 inches in diameter, and 53 inches from center to center. The length of wheel-base, measuring from the center of back driving-axle to the center of the truck, is 15 feet 5½ inches. The cab of the engine is on top of the boiler, and the dome near the front end. The fireman feeds the furnace from the tender, as there is no foot-board on the back end of the engine. The frames behind the driving axles have an offset so that the fire-box can be made wider than on ordinary engines. The grates are 58¼ inches long by 42¼ wide, the boiler 48 inches in diameter, and the tubes 2¼ in. by 14 feet long.

These engines were until quite recently built with separate cut-off valves, and the old-fashioned hook motion. The more recent ones have a stationary link, which, it is said, the runners like better than the hook motion, which probably will not surprise most of our readers.

That this plan of engine, which was originally designed by Mr. Hayes, now on the Illinois Central Railroad, has many features which must recommend it, we believe all must admit who will give it a careful examination and candid judgment. The most obvious criticism is that the plan is old-fashioned, which, if applied to the details, would be quite just, as many of them are not worked out with the skill or taste now expected in modern locomotives.

WHEEL SHOP.

Until quite recently *all* the locomotives on the Baltimore & Ohio Railroad were equipped with cast-iron tires. So long as the comparison was between cast and wrought iron, it was asserted by those most capable of judging that cast iron was much the most economical. When, however, cast iron had to run against steel, a different conclusion was reached, and now the latter is gradually gaining ground and displacing cast iron.

As many of our readers know, cast-iron tires were never shrunk on the wheels, but are fitted on with a tapered fit, and then secured by bolts. Fig. 1—which is drawn half size—represents a section of such a tire through one of the bolts. The tire is turned out tapered on the line *AB*. The amount of taper is ¼ in 5 on one side, or ½ in 5, measuring on diameters. *C* is a hook-head bolt, which is let into a recess cast in the wheel-center to receive it. The form of this recess is shown in fig. 2, which is a side view of the bolt and adjoining parts. It will be seen that the nut of the bolt is received by a recess or "counter-bore" which is cast in the wheel-center, but, as its name indicates, the segment *D'* which is taken out of the tire is bored out with a drill. The object in letting the nut into this recess is to keep it from projecting inside of the tire. The hooked head is let into a notch in the tire so as to be flush with the outside. This notch and the segment of the counterbore are the only parts of the tire cut away to receive the bolts.

In order to get the tire true on the wheel, the face of the latter is turned off, and the edge of the tire at B is chamfered off (not shown in the engraving) sufficiently so that when the tire is drawn in to the proper position, the edge of the chamfer and the face of the wheel will correspond. The tire is counter-bored a little deeper than the wheel, so that when the nut is screwed up the head of the bolt will have some "draw" on the tire. After it is screwed up, the thread is "nicked" with a centre punch to prevent the nut from turning. The wheels have such bolts at every alternate spoke.

The cast-iron tires used on the Baltimore & Ohio Railroad have been put on in this way for ten or twenty years, and when steel was introduced, it quite naturally occurred to the master mechanics and master of machinery that this plan was just as applicable to steel as to cast iron, and, therefore, all the steel tires used are put on in this way, and are found to work very satisfactorily. The tires are bored out in a horizontal boring mill, to gauges for both the taper and diameter, so as to insure uniformity.

The advantages which are claimed for this plan of putting on tires are: first, that the tire is not subjected to any undue strain from shrinkage, as is frequently the case when they are shrunk on; second, that the tires can be put on and taken off without removing the wheels, and in much less time, and without injury to the paint. It is said that a complete set can be taken off and a new one put on in five hours, which is certainly a great saving in time over the common method. The wheel work is all done under the supervision of Mr. A. R. Hobbs.

The upper floor of the two-story machine shop known as "No. 11 shop" is devoted to light iron-working machinery. Mr. James F. Stewart is the foreman of this shop. The equipment consists of thirty-four lathes, nine planers, two drill presses, one slotting machine and one pipe-cutting machine. At one end of the building is a small room devoted exclusively to the repair of steam-gauges and spring-balances. We were much interested in observing the manufacture of lead car seals, which consist of a circular piece of lead about the size of a nickel cent, with two convex surfaces and two holes through it. These receive the two ends of a wire, which is formed of strands twisted together. The object of these seals is to fasten up freight cars in such a way that on reaching their destination it will be obvious whether they have been opened after they left the place from which they were dispatched. The piece of twisted wire is therefore passed through the hasp on the car-door and through the holes in the seal. The lead is then compressed with a suitable punch and seal, so as to leave a distinctive impression which will be defaced if any attempt is made to open the door. Twisted wire is used so that it cannot be drawn out after the seal is compressed.

The seals are cast in a brass mould in which a bent piece of smooth wire is inserted, which forms the core for the holes. This is withrawn as soon as the lead cools. Large quantities of these seals are now used on the Baltimore & Ohio Railroad and its connections.

The second story of shop No. 11 is partly devoted to wood-working machinery, and part to that for iron. The former is, however, soon to be removed to make room for the new iron tools ordered, and the wood work will be done in the new saw mill, which we will describe hereafter. The iron-working machinery consists of seven planers, five lathes, one set-screw machine and one drill press.

At the south end of the building are two small rooms devoted to the manufacture and repair of locks, car fittings, tele-

graph instruments, etc. Ten men are employed, and they make all the fittings for cars which are used on the road, with the exception of a few patented articles. All the steel dies, name plates, etc., are cut or engraved in this department. Charles Kemmel superintends this work.

NO. 2 SHOP.

On the opposite side of the main track from the machine shop is an old round-house, which is now used for doing general repairs on locomotives, of which Thomas Trezide is foreman.

"RUSSIA."

The shops which we have described, with the exception of a row of twenty engine houses, located about a quarter of a mile west of the main shops, are all that are employed on engine repairs and construction. At the time these were built, the location was derisively named "Russia," on account of the absurd distance from the main shops, and partly, we suppose, because they were proposed by Mr. Winans, who was then interested in the operation of railroads in that country. The name, like many others applied jestingly, was appropriate, and has been used ever since. Each of these houses will receive one engine and tender, and is located at an angle of about 30 degrees with the main track, as shown in fig. 3, in which

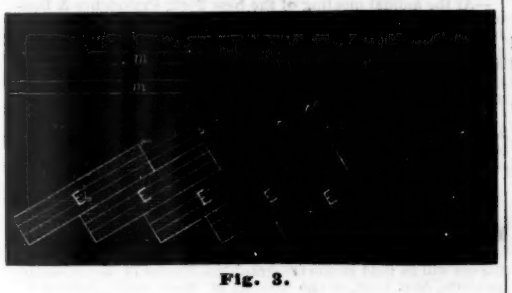

Fig. 3.

E, E, E are the engine houses; *m, m* the main track. Each of the houses has a switch connecting it with the main track. This plan is, however, expensive, and requires much room, and creates a very complicated net-work of switches, frogs, etc., and has not met with much favor.

In our description we omitted to mention the old No. 3 shop, which is a segment of a round engine-house, and is devoted to tender frames and trucks, and is managed by Mr. Oliver Miller. It has eight stalls, and all the tender work is done there.

FREIGHT-CAR SHOPS.

The principal freight-car shop is built similar to an ordinary round engine-house, with a turn-table in the center. Mr. James Miller is foreman of this work. The shop has sixteen tracks, five of which are devoted to new work and the others to repairing old cars. From 65 to 70 new cars are built here every month, besides keeping up the repairs of the extensive equipment of the road.

The freight-car truck used on this road is very different from that used elsewhere, but as we are promised a drawing of it we reserve the description until the appearance of the engraving. The bodies of the box freight cars for this road are made 30 feet long outside, by 8 feet 4 inches wide, and 6 feet 3 inches high inside, measuring from the top of the floor to the under side of the rafters. The weight averages 20,000 lbs.

PASSENGER-CAR ERECTING SHOPS.

The two buildings devoted to this work are built of wood, and are the only wooden structures of any considerable size about the place, all the rest of the shops are built of brick. They are located side by side, and are about 200 feet long and each about 75 wide. The passenger-car department is under the general charge of Mr. Jacob Shryack. The cars which are now made here are 51 feet 7 inches long and 9 ft. 6 in. wide over the outside of the body. The seats are placed 36 inches apart from center to center, and are made 18 inches wide by 39 inches long, thus giving abundant room for comfort. We observed, too, that although the seats are not upholstered so as to be concave, they were made almost flat, with Cobb's elliptic springs, which are sufficiently flexible, so that the seat becomes concave with the weight of the person sitting on it.

The cars have six-wheeled trucks with strong check-chains attached, in which we find those in charge of the cars have implicit confidence. Fifty-four passengers can be seated, with a water-closet and two stoves. The outside sills are made 7½x5½ inches, the intermediates 7½x 3½ inches, the posts 3x1½ inches, the "edge-board" 11½x2½. The windows and doors are all made with semi-circular tops. The doors have sliding sashes, which can be opened for ventilation. The raised roofs all have Creamer's exhaust ventilator. His supply ventilators are also placed under the eaves to admit air. The heating is done by ordinary cast-iron box stoves of the plainest and simplest description, and are said to give excellent practical results.

The cars are finished inside in walnut and satin-wood, and the panels are made of French walnut "burl." The doors are made of mahogany. The arms of the seats are wood, and the backs are curved so as to conform to the person of each passenger, and have locks with which they are fastened. The upholstering is secured with metal bands around the edges, and the head-linings are made by Howard, of Hartford. The finish and appearance of the cars is very showy—a little too much so to be in good taste; but it is what the general public like, which is the æsthetic standard for railroad companies.

The water-coolers are enameled inside, and are made by a person who is so unwise as not to put his name and address on what he makes.

About three passenger cars per month are built here, which we believe are fully equal to those made at any other shop in the country.

PAINT SHOP.

We can say, we think without much fear of contradiction, that the paint shop of the Baltimore & Ohio Railroad is the finest in the country. The plan is of the form of an *L*, the angle of which is somewhat acute. The length of it is 223 feet on the base, and 372 in the perpendicular, and the lower limb is 90, and the upper one 95 feet wide. In the lower limb five tracks run lengthwise of the building, and there is room for three cars on each track. In the other portion of the building there are nineteen tracks, which run crosswise of the building. There is, therefore, room for about thirty cars at one time. Under the portion which we have represented by the upper portion of the *L* is an extensive basement divided into rooms for storing and mixing paint, and for varnishing and upholstering. The paint is stored in a large fire-proof vault. The mixing rooms are adjoining, and the varnishing room next to it. This latter we think is defective in its arrangements for ventilation, for which no special provision is made. An examination of the room used for the same purpose by the Jackson & Sharp Co., of Wilmington, will we think suggest improvements in this respect, which would increase very much the efficiency and also the healthfulness of this room. In a previous number of the GAZETTE we described the arrangement used in Wilmington, to which those interested in it are referred. Mr. James Reeves is foreman of the paint shop.

UPHOLSTERING DEPARTMENT.

Two of the large rooms are used for this work, and everything here is done in the most thorough manner. The best material is used and good workmen employed. All travelers will realize the extent to which their comfort is dependent upon the work of the upholsterer. The rooms devoted to it are as orderly as any manufactory we were ever in, and few persons can realize the amount of material consumed in this department, without a personal inspection. Mr. O. G. White superintends it.

HORSE STABLE.

A considerable part of the business of the Baltimore & Ohio Railroad Company, including all its through traffic with New York, must be taken through the streets of Baltimore, where the cars are drawn by horses. The company must, therefore, keep a large number of them for this, and also for other service about their works. They have, consequently, erected a large brick stable with every convenience for taking care of 100 horses. The floor is made of wooden blocks, such as we have described above, which have now been in use for several years, and have done good service. The stalls are all 5 feet 8 inches wide, and thoroughly drained and kept in good condition. The centre portion of the building is three stories high, with room for the storage of feed, harness, etc., etc,

SAW MILL.

About twelve years ago a building intended for a sawing and planing mill was erected, which, it was then thought, was abundantly large for that purpose. In that time it has, however, become quite inadequate for the demands which have been made upon it, and it has just been pulled down and a larger two-story building, 227 x 70 feet, erected in its place. This is not quite finished, but a part is already occupied. In the lower story are the heavy planing machines and saws for dressing the heavy lumber. This is under the direction of Mr. L. A. King.

The upper story will be devoted to car cabinet work, of which immense quantities are required on a road like the Baltimore & Ohio. The latest and most improved machinery, and, what is of almost equal importance, plenty of room and light are provided for this work. Mr. George Harford presides here. The power for these shops is supplied by a pair of double engines with 17 x 24-inch cylinders and a large locomotive boiler, all of which were built at the Mount Clare Works.

LUMBER YARD.

East of the saw-mill and on the line of Pratt street are stored large quantities of lumber, which is piled up to season. It frequently happens, however, that the demand outruns the supply, and wood which is not seasoned must be used, which, in the long run, is poor economy.

THE MACHINERY OF THE BALTIMORE & OHIO RAILROAD.

A railroad man visiting this road for the first time will find many things which differ widely from the practice of roads farther north. The Baltimore & Ohio Railroad was among the first projected in the country, and a portion was completed before locomotive engines were more than experiments, and there are now living in Baltimore many old citizens who will tell with great glee about the old cars which were for a number of years drawn by horses on this road. To the men who first constructed the road and the machinery which was used on it much credit is due for their ingenuity and the rare ability which they showed in perfecting the machinery, road-bed and equipment of their line. It must be remembered that every step in the early days of this road was an experiment, and in one of the first reports may be found a very able discussion to determine, or rather show, why it was better to have the flanges of the wheels inside instead of outside of the rails. The road was laid originally with strap rails on granite blocks. Cars were tried propelled by horses mounted on the cars and working on an endless-chain platform. Sails were used, and finally the board of directors offered a prize for the best locomotive, which was contended for by several parties and which resulted in establishing conclusively the practicability of using steam for the motive power of their road.

Owing to the steep grades and sharp curves, the construction of powerful locomotives presented many grave engineering difficulties, and the problem, which of late years have been so much discussed in Europe, were presented twenty-five or more years ago on the Baltimore & Ohio Railroad. Mr. Winans furnished a large number of eight-wheel connected engines for this road, many of which are still at work, and the merits of this form of engine, as compared with that of ten-wheeled engines with a vibratory leading truck, were very earnestly discussed by Mr. Winans during the administration of Mr. Henry Tyson, who was for a number of years master of machinery. The decision of the question was against the eight-wheeled connected engines, and resulted in the almost entire destruction of Mr. Winans' business. Since then his shops have been torn down, and now no vestige of them remains, excepting the old building formerly used for a pattern shop.

The old gentleman, however, still lives, and his mind is as clear and logical as ever, and he is ready to, and does, maintain his opinions as earnestly and tenaciously as of old. He has of late years been devoting his time to the construction of dwellings for persons of moderate means, in which he has attempted to combine, as far as possible, all that is needed to make them comfortable and healthful. At present he is giving much time to the investigation and discussion of the improvement of Jones' Falls, so as to avoid all dangers from floods in future, one of which, it will be remembered, was very disastrous to the city of Baltimore a few years ago. Mr. Tyson and he are again on opposite sides, and to any who wishes to study hydraulic engineering, and at the same time be diverted by a very earnest discussion, we recommend the current literature relating to this subject which has appeared in the newspapers and elsewhere in Baltimore during the past year or more.

The "Nation" on Railroad Progress.

Some curious phenomena which, in an economic point of view, are of importance, arise out of the rapid growth of railroad communication during the last quarter of a century. Such of these phenomena as concern the methods and extent in which railroads augment the material wealth of the country have been long and anxiously discussed among our people. Very positive opinions on these points are widely diffused, though not, perhaps, very thoroughly explored; and the belief is that a good railroad, well managed, and with proper feeders and connections, becomes in a few years a creator of products and a mine of wealth to the whole belt of country through which it passes.

Two general benefits are ascribed to railroads independently of the gain they confer on investors. First, railroads enhance the value of the real estate near which they run; and, secondly, they develop commerce and industry by opening new markets, by economizing the time and expense of travel, by raising wages, by cheapening raw material and food, by diffusing facilities for the division of labor, and by increasing in other respects the productive power of the community. The amount of wealth which in these two ways is conferred by railroads varies, of course, in different parts of the country. But the increase has been roughly estimated at an average of ten times the cost of the road. In other words, those who believe this estimate correct would say that the 7,000 miles of railroad which we constructed last year and the 5,000 miles we shall probably complete this year are worth ten times their cost to the country, even should the roads themselves fail to pay the stockholders a single dollar. It is through the popular recognition of this principle that railroads, as creators of public wealth, have claimed and received grants of public lands and subsidies of town bonds, county bonds, State bonds, and, in the exceptional case of the Pacific railroads, extensive land grants with subsidies besides from the municipal and national governments.

To such public benefactions we must in part attribute the active growth of our railroad system, which has been more rapid than that of any other country in the world. Before 1848 we had few railroads; but the industrial activity generated by the gold discoveries gave an impulse to railroad building, and at the outbreak of the war in 1860 we had spent 1,070 millions of dollars on our thirty thousand miles of railroads. We have now 62,000 miles in operation or approaching completion; and we have built since the close of the war some 27,000 miles, which is a larger aggregate than the whole rails of France, Germany and Austria combined. The question has often been asked of late whether we have not been going at too rapid a pace, and whether our railroad progress ought not to cease. We have invariably answered in the negative, and have contended that the danger for some years will be not in our making too many railroads, but in our bad location of them, in dishonest management, in the tricks, combinations and concentrated power of speculators and other improper men who get into places of trust. In these respects, and in some others of a kindred nature, lie the chief dangers of our railroad progress; for it is still very incomplete, and many years of active construction are needed before even the most important of the missing links in the vast chain of interior communications can be supplied.

Such is the opinion we have expressed, and it seems to be the one most in favor with the public and with the press. An exception must be made in regard to the *Nation*, an article from whose pages we gave our readers a fortnight ago. The *Nation* intimates that the popular enthusiasm for railroads is all wrong, that we have been building too many railroads, and that they are mere "lotteries," as many of them pay no dividends.

EXTENT AND VALUATION OF FARMS.

	Acres of Lands Improved.		Cash Value of Lands in Farms.		Farm Implements.	
	1870.	1860.	1870.	1860.	1870.	1860.
			$	$	$	$
Illinois	19,339,952	13,096,374	920,506,346	409,944,033	34,576,567	17,235,472
Indiana	10,104,279	8,242,183	634,804,189	356,712,175	17,676,591	10,457,997
Iowa	9,256,467	3,792,702	302,862,441	119,899,547	20,509,562	5,527,023
Kansas	1,971,063	405,462	90,327,040	12,256,239	4,563,319	727,694
Michigan	5,096,329	3,479,296	309,240,579	169,836,495	13,711,979	5,819,832
Minnesota	2,322,162	556,250	97,847,442	27,505,922	6,731,120	1,018,183
Ohio	14,469,133	12,625,394	1,054,465,226	678,132,991	25,692,767	17,538,832
Oregon	1,116,290	806,414	22,352,969	15,200,593	1,293,717	952,313
Wisconsin	5,899,343	3,745,167	309,414,084	131,117,164	2,112,937	3,758,847

NUMBER OF LIVE STOCK, TOTAL ESTATE AND LENGTH OF RAILROADS

	Live Stock Number.		Total Estate. Valuation.		Total Length of Railroads.	
	1870.	1860.	1870.	1860.	1870.	1860.
			$	$		
Illinois	149,756,696	72,501,225	764,787,000	389,207,372	4,823	2,790
Indiana	83,776,742	41,835,539	663,455,944	411,042,424	3,177	2,163
Iowa	62,967,133	22,478,293	368,088,165	205,166,905	2,683	655
Kansas	23,173,185	3,332,450	99,254,430	52,518,232	1,561	none.
Michigan	49,809,869	23,714,771	292,908,809	163,533,905	1,638	779
Minnesota	20,118,841	3,642,941	94,160,368	32,018,797	1,072	none.
Ohio	120,380,523	80,284,819	1,512,437,886	959,861,101	3,538	2,946
Oregon	6,829,675	5,946,255	31,736,519	19,024 915	159	none.
Wisconsin	45,310,882	17,907,375	333,447,589	156,226,169	1,513	905

For some reason the *Nation* gives special pungency to his attack on the Western railroads. If he really doubts whether the West is benefitting from its railroads let him take the census

reports, and as he notes how in each State the farms have multiplied, and how the houses and lands have risen in value, how the products of the earth have augmented and the riches of the people have grown, let him recognize the fact that all these movements result from and are largely created by the money spent in building railroads. The above table shows how, in various degrees, some of the Western States have advanced between 1860 and 1870, and a few of the particulars suggested for comparison.

It is a long time since we have seen in the thoughtful columns of the *Nation* an article running so contrary to sound popular opinion. Nearly forty years ago Michel Chevalier came to this country, and found us so enthusiastic about railroads that he repeatedly mentions the fact in his letters. If he were to come here to-day he would find us the same. Even the *Nation* confesses that "a sort of mania as regards railroads may be said to exist." Our enthusiasm has survived the shocks and changes of forty years. Experience has caused no abatement, but it is if possible more vehement with ripening age.

No doubt we have built during this period a number of railroads which, like Erie, do not pay dividends. But, like Erie, they are most of them invaluable aids to the commerce of the country, and they can be made to earn dividends by a more honest, more economical, more faithful management. Besides, there are fewer of such non-dividend paying roads in this country than the *Nation* seems to suppose. There has come a period in the history of many railroads when their securities have ceased to be a football in Wall street, and have taken their place among sound, dividend-paying investments. Every year the circle of such roads is increasing, and it will at length comprehend almost the whole.

It is also true that many persons have lost money in railroad investments. But few persons that took hold of such investments prudently and kept hold of them through all discouragements have failed to save themselves in the long run, or to make money by their ventures. It is not fair to blame our railroad system for the wreck of speculative operations based on little capital, sustained with less judgment, and hindering rather than speeding railroad progress.

Neither is it fair to impeach our railroad system while yet incomplete, and to denounce it as a "lottery" because, as the *Nation* says, the net earnings of the whole of the railroads in the United States amount but to *five per cent.* on their cost. Does our contemporary happen to remember what are the net earnings of the English railroads? The aggregate is less than five per cent., as we shall presently show. This argument, then, of the *Nation* proves too much. The cost of our railroads he states at three thousand millions of dollars. This vast sum having been expended for their construction, what is the amount they earn for their owners? Let us quote the evidence which the *Nation* offers on this point:

"The gross annual earnings of this system are about $445,000,000, of which not more than 33 per cent. can be set down to net profit, or a total of $150,000,000—being *exactly five per cent. on the cost.* * * * Dividends on capital stock represent, however, but a small portion of the net earnings of the system, the great bulk of which is necessarily devoted to the payment of interest and to development. As regards the proportion which their reported net earnings, whether devoted to dividends or however applied, bear to the entire cost of their construction, the roads of Massachusetts appear to be the most prosperous in the country, their percentage rising as high as 8.41; Pennsylvania comes next with 8.3; Connecticut reports 7.16; New York, 7.5; while Ohio, the only other State which furnishes reliable returns, falls as low as 4.9 per cent."

Our contemporary reminds us of the veracious little story related of an eminent member of the English bar, whose boast it was that he seldom read his brief beforehand. He one day rose in court and argued his case dead against his client, and was at length stopped by the whisper from his junior, "We are on the other side." The *Nation's* facts are dead against his theory. He says our railroads are a lottery, and he proves that they earn a larger percentage on their cost than the English railroads earn. The *Nation* will scarcely venture to say that the British railroad system is a lottery, offering blanks and few prizes to its investors. Let us look at that system and see how it compares with ours. In 1871 the capital of the British railroads was reported at £520,400,000, the total traffic £46,711,125, the working expenses 48.8 per cent., the mileage 14,700 miles, the percentage of traffic receipts to capital expended in building the lines, 8.98 per cent. Of their earnings, about one-half was net profit, amounting to 4.49 per cent.

* * * * *

If, then, the facts are as exhibited by the *Nation*, the railroad system of this country, notwithstanding its acknowledged defects, is found to yield a greater percentage of revenue to its owners than the rich, productive railroad system of Great Britain. It must also be remembered that the density of the population gives the English roads manifest advantages over ours; there being in that country 1,400 persons for every mile of railway, while we have but 700 persons per railroad mile. Moreover, our railroads are spread over an immensely wider tract of country, for Great Britain covers but 89,000 square miles, against 2,992,879 square miles for the United States. If, notwithstanding these disadvantages, our railroad system is as productive as the *Nation* says it is, then we apprehend that most of our people will accept its past success as a present gain and a harbinger of better things to come.

As to the irregularity of the dividends of railroads and the small proportion of the net earnings which goes to the stockholders of a large number of lines, this is accounted for by the *Nation* on the usual plea that much of what the roads earn is expended in improvements. This we think is not a sufficient apology for the disparity, though it is so often put forth for the purpose. But of this matter, with others, we must defer the consideration to a future article.—*Commercial and Financial Chronicle.*

PERSONAL.

—It is reported that Mayor Joseph Brown, of St. Louis, President of the Pacific Railroad Company, is dissatisfied with the management of the property by the lessee and will withdraw from the directories of both Pacific of Missouri and Atlantic & Pacific.

—Mr. J. M. S. Williams, who was Treasurer of the Union Pacific Company when it was constructing the road, has been nominated for Congress by the Republicans from the Cambridge district in Massachusetts.

—Jefferson C. Rowe, the brakeman who was caught between the platforms of two cars at the Revere accident on the Eastern Railroad, and held with his legs crushed for a long time before he could be released, has sued the Eastern Railroad Company for $35,000 damages.

—Ben Holladay was not elected United States Senator from Oregon, as a German correspondent had intimated he would be, and was not even a candidate before the Legislature; but Mr. M. C. Mitchell, whom Mr. Holladay favored for the place, and whom his opponents called Ben Holladay's man, was chosen.

—Mr. Henry S. Nourse, Chief Engineer of the Midland Railroad, got off a train on that road at New Durham, N. J., September 23, and, while crossing the track of the Northern New Jersey road, which at that place runs parallel and close to the Midland track, was struck by the locomotive of the Nyack express and severely injured.

General Railroad News.

CHICAGO RAILROAD NEWS.

Chicago & Northwestern.

This company have during the past summer, purchased 280 acres about ¾ of a mile west of Central Park and fronting on Kinzie and Madison streets and Crawford avenue, on which the company have determined to build large machine shops and car works, next season. Other parties have purchased several hundred more acres in the same vicinity, and within two years at most, a large and important suburb of the city will spring up at this point. In order to make the new shops perfectly accessible, the Northwestern Company have secured within the past week the right of way for a new track, which will extend directly north five miles to a junction with the Wisconsin Division of the road at Irving Park, and this is about one mile southeast of the point where the Milwaukee & St. Paul Railway will cross the main line of the Northwestern. The contract for grading this new branch has been let, and it is to be finished this fall. After its completion all the cattle trains, through freight and empty cars will be switched off at Irving Park and sent to the southwestern quarter of the city by way of the Kinzie street track and the track of the Pittsburgh, Cincinnati & St. Louis road to the new transfer depot which is to be constructed on the South Branch. The company have there property which will afford them a dockage of 4,000 feet on both sides of the slip between Wood and Robey streets, and which extends from Twenty-second street to the South Branch. This new transfer house will be a great convenience both for the company and the city, since it will greatly facilitate and hasten the transfer of all heavy and bulky through freights. The car works above referred to will be very extensive, and will employ at least 2,000 operatives when they are completed.

Chicago, Danville & Vincennes.

A disagreement has arisen between this company and the city of Chicago, with reference to the construction of the company's tracks within the city limits. The company claims the right, and has exercised it, to construct its track south of Carroll street, east of Reuben. The right is claimed from franchises conferred to the company in 1866 by the (then) Great Eastern Railroad Company. The Mayor, the Corporation Counsel and the Council Committee on Railroads, on the contrary, claim that the Chicago, Danville & Vincennes Company have no shadow of right between Western avenue and Morgan street to lay a track south of the north line of Carroll street. The Council, it is believed, will order the removal of the track already laid on the debatable ground.

Chicago, Burlington & Quincy.

The Chicago & Rock River Railroad, running from Shabona, on the Chicago & Iowa road, 30 miles west of Aurora, to Rock Falls, opposite Sterling, Ill., will be taken possession of by the Chicago, Burlington & Quincy Company on Monday, October 7, after which period it will form a new branch of this road.

Mr. Robert Harris, recently elected Superintendent of the Quincy, Alton & St. Louis Railroad, has not accepted the position, his duties as General Superintendent of the Chicago, Burlington & Quincy requiring all his attention.

Lake Shore & Michigan Southern.

The company has accepted the section of road between Albion and Eaton Rapids, Mich., and will begin to operate it on Monday, October 7. Passenger trains will arrive at Eaton Rapids at 10:25 a. m. and 9:35 p. m., and leave the same place at 11:25 p. m. and 5 a. m.

Illinois Central.

The company is about to build a new freight depot at Dubuque, Iowa. The building will be 55 feet wide and 300 feet long, and one story high, except for a space of 40 feet, where it will be two stories in height, the second story being used for offices.

The company is preparing to extend the Weldon shops, where, besides the extensive repairs many new locomotives are constructed.

Michigan Central.

The Jackson *Citizen* reports that Mr. Sargent, the General Superintendent, has issued orders forbidding the sale of intoxicating drinks of every kind in all the eating saloons belonging to the road to remove as far as possible the possibility of the employees drinking while on duty.

ELECTIONS AND APPOINTMENTS.

—Mr. H. P. Nicholls, for the past 20 years station agent at Worcester of the Boston & Albany Railroad, has been appointed Assistant Superintendent of the road at Boston, in place of Abraham Firth, resigned.

—Mr. John Houston, for many years employed on the Erie Railway, has been appointed Chief Engineer of the Mejillones & Caracoles Railroad, in Peru.

—Mr. Simeon Gallup, of Groton, Conn., has been appointed one of the Railroad Commissioners of Connecticut, to succeed James Pike, of Sterling, resigned.

—The annual meeting of the Connecticut Valley Railroad Company was held at Hartford, September 24, when James C. Walkley was chosen President, L. Boardman Vice-President, Levi Woodhouse Secretary, and N. Hollister Treasurer.

—Mr. H. D. V. Pratt, lately appointed General Superintendent of Transportation on the Erie Railway, has made the following appointments of subordinates: R. B. Cable, General Assistant Superintendent of Transportation; G S. Reddington, Assistant Superintendent of Transportation, with charge of the Eastern and Delaware divisions and branches; C. W. Gardner, Acting Assistant Superintendent of Transportation, with charge of the Susquehanna and Rochester divisions and branches; R. G. Taylor, Assistant Superintendent, with charge of the Western and Buffalo divisions and branches. Mr. Reddington has been Superintendent of the Delaware Division, and Mr. Taylor of the Buffalo Division, for some time.

—At the annual meeting of the Ripley Railroad Company, held in Ripley, Miss., September 16, W. C. Falkner was re-elected President, W. R. Cole was chosen Treasurer, and A. W. Gloster Chief Engineer.

—Mr. James C. Hall has been made Treasurer and Mr. Robert G. Moulton Sales Agent of the Delaware & Hudson Canal Company.

—Mr. Abraham Wakeman has been chosen President, Mr. T. C. Goetchius Vice-President, and Mr. Charles S. Brown Managing Director of the Hempstead & New York Railroad Company. Mr. Litchfield has withdrawn from the management.

—Mr. James C. Wakeley, of Higganum, has been chosen President of the Connecticut Valley Railroad Company for the ensuing year.

—Mr. Robert French, long a conductor on the Baltimore & Ohio Railroad, has been appointed Supervisor of Trains on the Second Division of that road, extending from Martinsburg to Piedmont.

—At a meeting of the Baltimore, Pittsburgh & Chicago Railway Company, Indiana Division, held at Auburn, Ind., September 26, Walter C. Quincy, of Columbus, Ohio, was elected President; William Wing, Secretary; W. H. James, of Baltimore, Treasurer, and James L. Randolph Chief Engineer. Mr. Quincy is a director and Mr. Wing Secretary of the Central Ohio Railroad Company.

—Mr. Andrew Anderson, of Baltimore, has been appointed General Manager of the New York & Washington Air Line, in place of Mr. W. Prescott Smith, who was lately appointed Master of Transportation of the Baltimore & Ohio Railroad.

—At Jonestown, Pa., September 24, Mr. W. H. Bell, of Branchville, N. J., was chosen President; David M. Bank, East Hanover, Pa., Vice-President; Jeremiah Heilman, Jonestown, Pa., Treasurer, and Jacob G. Heilman, Jonestown, Pa., Secretary of the South Mountain Railroad Company. These are all re-elections.

—Mr. Albert Mapes, formerly a conductor on the Kansas Pacific, has been appointed Superintendent of the Western Division of the Pacific Railroad of Missouri, in place of M. C. Witbeck, resigned.

Mr. John MacLeod, Division Engineer of the Elizabethtown & Paducah Railroad, has been appointed Engineer and Superintendent of Road for the same line.

—General E. P. Alexander, formerly Chief of Artillery in Longstreet's Corps in Northern Virginia, has been elected President of the Savannah & Memphis Railroad, *vice* Colonel W. L. Salisbury, resigned.

—Mr. J. G. Crockett, formerly Master Mechanic of the Western Division of the Chicago, Rock Island & Pacific Railroad, has been appointed Master Mechanic of the new Chicago, Dubuque and Minnesota Railroad, with headquarters at Dubuque, Iowa.

—At the annual meeting of the New York, Providence & Boston Railroad Company recently, Samuel D. Babcock, James B. Johnston, Charles Morgan, William F. Cary, Jr., Edward Morgan and David S. Babcock, of New York; John A. Burnham, of Boston; S. B. Stone, of Stonington, Conn.; and Nathan F. Dixon, of Westerly, R. I., were elected directors for the ensuing year. All the above are re-elected.

—Mr. S. S. Hand, late agent of the Lake Shore and Michigan Southern Railway at La Porte, Ind., has accepted an appointment as General Freight Agent of the Wisconsin Central Railroad.

OLD AND NEW ROADS.

Meetings.

The first regular fall meeting of the Society of Practical Engineers will be held in the Geographical Rooms of the Cooper Institute, New York, on the evening of Wednesday, October 9. The meeting will be devoted to a consideration of the business and transactions of the Society during the fall and coming winter. A full attendance is desired and an interesting discussion is hoped for.

New York, New Haven & Hartford.

The stock transfer books of this newly consolidated company have been open since the 2d day of October, after which date holders of stock in either the New York & New Haven Railroad Company or the Hartford & New Haven Railroad Company could, upon surrender of their stock certificates, receive certificates of the stock of the "New York, New Haven & Hartford Railroad Company" in lieu thereof, share for share. No transfers of stock of either the New York & New Haven Railroad Company or of the Hartford & New Haven Railroad Company can hereafter be made, the transfer books of both said companies having been permanently closed.

Baltimore & Ohio.

In order to carry out the intention of making Locust Point the depot for the reception of freight and passengers from the Philadelphia road, the company has purchased all the property northeast of Fort Avenue and between Fort McHenry and its present property at Locust Point. Active preparations are being made for the erection of wharves, depots, warehouses and a very large elevator.

Baring Brothers have brought out in London the prospectus of £1,000,000 of an authorized issue of £2,000,000 of 6 per cent. mortgage bonds of this company, which are offered at 97.

Paris & Decatur.

This company has made an agreement with the Decatur, Sullivan & Mattoon to use the same track from Mount Zion, about seven miles from Decatur. This track will intersect the Illinois Central about half a mile below the Sangamon bridge, and from that point both roads will use the track of the Central road into Decatur. It is expected that both roads will be completed by December 1.

Springfield & Northwestern.

The road bed is nearly ready for the iron from Springfield to Antioch Church, a distance of 11 miles.

Long Island Central.

The opening of this road has been postponed on account of defects in the road. The Flushing (L. I.) *Times* says:

"This defect, if we believe our informants, amounts to little less than a swindle on the part of the contractors. The bridges are in some cases too low to admit the passage of engines, and in nearly every case were so shabbily built that over 800 barrels of cement have already been used in filling up holes left by the builders. The company have contracted for and have paid for a first-class road, and to find themselves, at the very moment of an anticipated successful opening, disappointed in the most important feature, is certainly very aggravating. The rolling stock secured is unsurpassed by that of any road in the country, and the directors will not trust it on a road-bed which is not as perfect as it may be possible to make it."

Lake Ontario Shore.

The rails are laid to Red Creek, about five miles from Fair Haven, the late terminus.

Annapolis & Elk Ridge.

New rails have been laid to Camp Parole, the culverts are being cleared out, and the whole road is to be thoroughly renovated.

Alabama & Chattanooga.

The Chattanooga (Tenn.) *Times*, of September 23, says:

"Yesterday morning, in accordance with the decree of which a synopsis was given in the *Times* of Sunday, Judge Harralson took possession of all the property of the Alabama & Chattanooga Railroad, rolling stock, etc. Inventories of the property are being made out as fast as possible, and in a few days he will be in undisturbed possession of the entire line from this city to Meridian. As soon as this is accomplished a sufficient number of men will be employed to repair the track, and the shops here will be opened and a large force of hands employed in repairing locomotives and cars.

"Mr. J. C. Stanton will arrive this evening, and will at once assume the duties of Superintendent, under the receivers.

"A new company has been organized, composed chiefly, we understand, of the holders of the first-mortgage bonds, who have paid the State the full amount demanded, and who stand ready to take the road off the hands of the receivers, as provided for under the decrees of the court, as soon as they shall have raised and expended the $1,200,000 in repairing the road, stocking and completing it.

"The first thing the receivers will do will be to repair and stock the road. If they have sufficient means they will complete it by building a track around Lookout Mountain to

Chattanooga, for which the right of way has been granted heretofore by the Legislature of Tennessee.

"We congratulate the people of Chattanooga upon the favorable prospect thus opened to them. It is true that the floating debt, including all past dues to laborers and contractors, is lost, as the *Times* has told them it would be, but all who have suffered a loss of their earnings will now have an opportunity to make their loss good by new business, and it is certain that while the road remained idle they never could have done even this.

"We desire to make this point as plain as possible, and we repeat that no merchant, no laborer and no contractor will ever receive a single dollar now due from the Alabama & Chattanooga Railroad Company. That debt has been wiped out utterly and completely by the adjudication in bankruptcy, in which the company itself has acquiesced, as well as Mr. J. C. Stanton, who claims to be the largest individual creditor. The old Alabama & Chattanooga Railroad Company is defunct. The new company which has been formed and which has purchased the road and its franchises from the State of Alabama, has no legal connection with the old corporation and is not responsible for any of its debts, although many of the individuals composing it may have been members of the old company."

A dispatch from Atlanta says that on the 25th ult. the Governor of Georgia seized the 30 miles of this road in the State of Georgia, alleging as cause the claim of the State for security on the bonds it has endorsed.

Massachusetts Central.

Most of the grading through Sudbury is finished. Work on the ledge in West Sudbury will not, it is thought, be finished before January next.

Detroit, Eel River & Illinois.

Work has again been commenced on the western extension of this road, and the company expects to have trains running from Denver, Ind., to Logansport in two months. The distance to be completed is 26 miles, which was partly graded last spring, but work was stopped by an injunction served on the company by the citizens of Logansport, which has now been removed.

Shanandoah Valley.

Of this road the Clarke County (Va.) *Courier* says: "The meeting of the stockholders of this company, which assembled at Front Royal on the 3d inst. (September), we understand fully carried out the purpose of the call, and authorized the President and Board of Directors of the company to issue the bonds of the company at the rate of $25,000 per mile, to be secured by first mortgage bonds upon the franchises and property of the company. A letter was exhibited to the Board of Directors from Judge Watts, President of the Cumberland Valley road, offering, if necessary, to aid in the construction of the extension from Shepherdstown to Hagerstown, including the building of the bridge across the Potomac at Shepherdstown, to the extent of twelve thousand dollars per mile."

Frederick & Pennsylvania Line.

This road was completed last week to Frederick, Md., 18 miles southwest from the recent terminus at York Road, Md. The road is virtually an extension southwestward of the Hanover Branch Railroad, which it will connect at Frederick with the Frederick Branch of the Baltimore & Ohio Railroad. Its total length from Frederick northwest to the Pennsylvania line is 28 miles, and the section thence to Hanover, 9½ miles, is owned by the Littlestown Railroad Company and worked by the Hanover Branch Company. In connection with the Metropolitan Branch of the Baltimore & Ohio it will make a short route to Washington from the country on its line and on the Hanover Branch. It is expected that it will carry considerable anthracite coal southward.

Boston & Lake Ontario.

The engineers have commenced to survey the line of this road in the town of Adams, Jefferson County, N. Y. This party is to continue the survey in a southeasterly direction until they meet the party working west from the Hoosac Tunnel in Massachusetts. The northern section of the road will be about 80 miles long. General Hungerford is President and J. C. Wright Vice-President of the company.

Missouri, Arkansas & Gulf.

This is the name of a company just organized in Arkansas to build the section in Arkansas of a railroad from Springfield, Mo., to the Gulf of Mexico. The length of the road will be about 625 miles, and the cost is estimated at about $25,000 per mile.

Syracuse & Chenango Valley.

The track is laid almost to Erieville, about 27 miles southeast of Syracuse.

Pittsburgh & Connellsville.

Fifteen acres of land are offered the company in Connellsville as a site for shops. If found desirable, it is said that the company will expend $250,000 there for buildings and machinery.

Washington County.

It is proposed to extend this branch of the Baltimore & Ohio from its present terminus at Hagerstown, Md., northeastward to Waynesboro, Pa., about 13 miles.

Vicksburg, Pensacola & Ship Island.

Vicksburg has subscribed $100,000, and Warren County (in which Vicksburg is situated) $300,000 to this road. The roadbed from Vicksburg southward to the Big Black, 17½ miles, is nearly completed. The route beyond the Big Black is not fully determined, but it is expected that it will intersect the New Orleans, Jackson & Great Northern either at Hazlehurst, Beauregard or Brookhaven. It is to be of 3-feet gauge.

Brunswick & Albany.

The German holders of the bonds issued (or guaranteed) by the State of Georgia in aid of this road have united in an organization which purposes to use every effort to enforce the collection of the interest or foreclose the mortgage.

Hempfield Railroad.

Pittsburgh papers having reported that the contracts had been made for the construction of the extension of this railroad from Washington, Pa., eastward to a connection with the Pittsburgh & Connellsville Railroad, the Washington *Examiner* says that these reports are inaccurate; that the only contract let is one to Mr. Boyd, of Baltimore, for a short section next to Washington, including a tunnel, and that it is not intended to let any other sections before spring, except, perhaps, two or three on which there will be very heavy work; and, indeed, that the route, except from Washington to Clokeyville, had not been definitely determined.

Pennsylvania Petroleum.

A statement having been made by a Philadelphia paper that this road has been abandoned, and that the labor done has not been paid for, Mr. F. A. Goddard, the Auditor, writes that the statement is "unequivocally false," and that the road will be completed this year.

New Orleans, Mobile & Texas.

This company reports that it is embarrassed in its efforts to raise money to extend its line by a distrust in the securities of the State of Louisiana, largely occasioned by a circular signed by 300 prominent citizens of New Orleans, which threatened repudiation of certain State bonds should they be negotiated. The State has agreed to issue $2,500,000 bonds in payment of a subscription of the stock of this company, intended to secure the extension of the road to Texas. A recent meeting of citizens called by the Railroad Committee of Fifty" of New Orleans passed resolutions that there was no intention to repudiate any portion of the bonds issued to this company, provided that it should complete its road to the Sabine and the branch to Shreveport, pledging themselves to assist the company in every way in their power; and expressing the opinion that there should be no further delay in beginning the work.

Columbia & Port Deposit.

Work has been resumed on this Pennsylvania railroad from Columbia southeast 13 miles to Harbor, Pa., along the lower Susquehanna.

New Castle & Franklin.

The contract for the 21 miles north by east from the junction with the New Castle & Beaver Valley Railroad, close to New Castle, Pa., has been let; and the remainder to Stoneboro, about 16 miles, is to be let as soon as the locating surveys have been made.

Texas & Pacific.

A telegram from San Francisco, dated September 30, says that San Diego has voted almost unanimously in favor of issuing city bonds for $150,000 with which to purchase the charter of the San Diego & Gila River Railroad Company and also depot grounds for the Texas & Pacific Company.

Boston, Hartford & Erie.

The track of the Dedham Branch, two miles long, which for some time has been unused, and mostly removed, was relaid between Saturday noon and Sunday midnight, September 28 and 29.

Chicago & Canada Southern.

The Supervisors of Wayne County, Mich., have voted, in the face of a strong opposition, to give this company authority to bridge the western channel of Detroit River at Trenton. An amendment prohibiting the construction of a bridge by the company over the eastern channel at any future time was voted down.

Bingham Canon Railroad.

A telegram from Salt Lake City, dated September 28, says that work was to begin immediately on a narrow-gauge railroad 17 miles long, from a junction with the Utah Southern to the mining district in Bingham Canon.

American Fork Railroad.

This narrow-gauge railroad, which is about 30 miles long, and is intended almost exclusively as a mining road, is now completed. It forms a junction with the Utah Southern.

Allegheny Valley.

A new issue by this company of $6,000,000 7 per cent. currency, or by the guarantee of the company 6 per cent. sterling bonds, which was owned by the Pennsylvania Railroad Company, were offered in the London market, September 13, at 88 per cent. specie of their face. The bonds are guaranteed by the Pennsylvania Railroad Company, which agrees to pay £6 sterling in London, or $35 currency in Philadelphia, for the half-yearly interest of each bond for $1,000. These bonds are to complete the "Eastern Extension" from the main line near Red Bank eastward to the Philadelphia & Erie road, at Driftwood, which is to be the low-grade freight line over the Alleghenies of the Pennsylvania Railroad.

Pennsylvania—Bonds Guaranteed by It.

It has been questioned whether this company has not incurred many dangerous obligations by guaranteeing the bonds of many new railroads. The following letter on this subject was written by the President, J. Edgar Thomson, to the London bankers who recently brought out the Allegheny Valley loan of $6,000,000, guaranteed by the Pennsylvania:

"With reference to the railway bonds bearing the guarantee of the Pennsylvania Railroad Company, which have been from time to time placed upon the English market, I am glad to furnish you with the following information, showing the object of such guarantee, and that, irrespective of it, those securities are amply provided for by the revenues of the lines upon which they have been issued.

"When the Pennsylvania Railroad was constructed, all railways in the West leading toward the seaboard were extensions of the New York Central Railway system, and built in its interest. It therefore became necessary to the success of the Pennsylvania Railroad Company that it should secure lines under its own control extending from its western terminus to the commercial centers of the West, viz., Cleveland, Chicago, St. Louis, Cairo, Louisville, Cincinnati, etc. All of which it has accomplished. To enable the railroad companies chartered for this object to build the several lines desired, the Pennsylvania Railroad Company has, from time to time, purchased their securities, and it is the bonds of the leading lines thus acquired that the company has offered for sale under its direct guarantee—such guarantee being strictly confined to the bonds of companies in which the Pennsylvania Railroad Company holds a controlling interest.

"All of the lines west of Pittsburgh controlled by the Pennsylvania Railroad Company, either by lease or otherwise, have, for convenience of management, been transferred to an organization known as the Pennsylvania Company, by which they are worked as one system. In the Pennsylvania Company, the Pennsylvania Railroad Company is practically the only shareholder. The results of the first year's operations of this company show that, after providing for the expenses of working its lines and the payment of all rents, guarantees or interest on securities for which they or the Pennsylvania Railroad Company are responsible, there is left a surplus profit exceeding one and a half million of dollars.

"In respect to the guarantees given by the Pennsylvania Railroad Company to securities issued for the construction of lines worked by them, as part of their parent system in the State of Pennsylvania, they are not called upon to make any contribution, the income of the lines guaranteed being sufficient to fulfill all their financial obligations.

"Whilst it has been the policy of the Pennsylvania Railroad Company to encourage and aid the construction of lines leading from its railway to the trade centers of the West, and as feeders to its main line, by extending its guarantee to the securities issued for the purpose of raising the necessary construction funds; so carefully and judiciously have those lines been selected with reference to their remunerative character, that so far from the guarantees given by the company becoming a burden to it, the leased and guaranteed lines are, and must continue to be, in the aggregate, a source of direct and large annual profit.

"The net revenues of the Pennsylvania Railroad Company from its own lines have always been more than sufficient to meet the interest upon its whole indebtedness and an annual dividend on its capital to its shareholders of 10 per cent., while it has at the same time accumulated a large contingent fund and also provided a sinking fund, which, with its accumulations, will be sufficient to pay off the whole of its mortgage indebtedness at maturity."

International.

It is reported that this company has had an agent in Mexico for some time, endeavoring to obtain from the Congress of that country authority for the extension of its railroad from the Rio Grande southwest to the Pacific at San Blas or Manzanillo, which would pass through many large towns, much fertile and cultivated country, and form a short route to the Pacific coast, though not to the United States Pacific coast.

Northern Pacific.

The new President, General G. W. Cass, has gone to visit the company's property in Washington Territory. It is reported that it will construct next year about 250 miles of the Columbia River line, extending from the head of navigation at Wallula eastward to the Montana line. It already owns the property of the Oregon Steam Navigation Company, with its steamboats and railroads around the rapids which make the present line from Portland to Wallula.

New Mail Routes.

Superintendent Bangs, of the railroad postal service, reports that mail service was extended over about 8,000 miles of road during the fiscal year ending June 30, 1872, and at the present rate the increase will be 10,000 miles during the current year.

Connecticut Valley.

The receipts for the year ending September 1 were $161,203, of which $64,031 were received during the last three months, being two-fifths of the entire receipts, showing the result of the increased facilities. The road being 46 miles long, these receipts were at the rate of $3,500 per mile, which, for the first year, is very favorable. The stockholders authorized the directors to issue second-mortgage convertible bonds to meet the floating debt.

Pacific of Missouri.

The following official statement of its condition was made by this company to the New York Stock Exchange, previous to the placing of its securities on the free list:

Organized under special charter of the State of Missouri.

	Miles.	
Main line, from St. Louis to Kansas City	283.75	
Carondelet Branch	14	
Total number of miles owned	297.75	
Missouri River Railroad (leased)	.25	
Leavenworth, Atchison & Northwestern	21.25	
Lexington & St. Louis	55.25	
Osage Valley & South Kansas (leased)	.25	
St. Louis, Lawrence & Denver	.61	
	—	187.50
Total number of miles owned and leased		485¼
First mortgage 7 per cent. gold bonds, dated July 15, 1868. Mature August 1, 1888. Principal and interest payable in gold in the city of New York. Denomination $1,000. Numbered from 1 to 7,000 inclusive.		$7,000,000 00
Second mortgage 7 per cent. currency bonds, dated July 1, 1871. Mature July 1, 1891. Interest payable January 1 and July 1. Principal and interest payable in New York City. Denomination $1,000 each. Numbered from 1 to 3,000 inclusive.		3,000,000 00
Real estate 8 per cent. currency bonds, four blocks of ground in the city of St. Louis. Mature May 1, 1892. Interest payable May 1 and Nov. 1. Principal and interest payable in New York City. Denomination $1,000 each. Numbered from 1 to 600		600,000 00
Denomination $500 each. Numbered from 601 to 1,600. Loan from St. Louis County 7 per cent. currency, not secured otherwise than by the company's obligation to pay the sum of $700,000 on February 1, 1885		700,000 00
Seven per cent. income bonds, dated Sept 1, 1872. Mature Sept. 1, 1892. Interest payable January 1 and July 1. Principal and interest payable in New York city		1,500,000 00
Capital stock		7,361,000 00
Total		$20,261,000 00

Registered at Shoe and Leather Bank New York city.

OFFICERS—President, Joseph Brown; Vice-President, H. E. Bridge.

The committee recommend that the first mortgage 6 per cent. gold bonds, the second-mortgage 7 per cent. currency bonds, and the stock be placed on the free list.

This is a total capital account of $68,047 per mile of road owned; and the debt is at the rate of the large amount of $43,600 per mile, on which there is an annual interest charge of $2,848 per mile. The earnings, however, are large on the mileage owned, and unless some of the leased lines should fail to earn their expenses, there ought to be a considerable surplus. The Atlantic & Pacific Company having leased the entire property, it has first to meet these charges as a part of the rental.

The European Mails.

The contract for conveying the Saturday's mail (the leading one) from New York to Great Britain has been awarded by the Postmaster-General to the White Star Line from October 1, 1872, to the end of 1873, and to the North German Lloyds, of Bremen, for carrying the closed mails for the Continent on Saturday.

Hungarian Railroads.

During the first six months of the present year, 30 German miles of railway were opened to public traffic in the Kingdom of Hungary, and on July 1 there were 204 German miles more in course of construction, about 50 of which have been completed and opened since that period. Of the remaining 145 German miles, at least 45 or 50 will be finished before the close of the year, so that the total extension of the Hungarian lines in 1872 will be 135 German, or about 675 English miles. A new and reduced tariff of charges came into operation on the 1st August, in which many facilities are granted, especially for the conveyance of grain, cattle and provisions generally at the low freight of 3 kreutzers per centner per German mile, equal to about 25 cents per ton per English mile.

Lower Egypt & Ujiji.

This will be a good enough name for a railroad which the Viceroy of Egypt talks of building up the Nile to the Soudan, on the borders of equatorial Africa, at a cost of something like $25,000,000, the distance being about 700 miles. A good demand for crocodiles would make it a profitable line.

Central of Iowa.

This company has recently issued its report for the year 1871. The report shows that the company had 179 miles of road at the beginning of the year, and 202 at its close, and that 31 miles (from Albia southeastward to Moulton) were partly graded. The President recommended that the section be completed the current year, and the securities placed on the New York Stock Exchange. The connections with St. Louis and St. Paul had not worked well; it not being possible to arrange trains so as to make close connections. The earnings, however, increased from an average of $1,625.71 per mile in 1870 to $2,380.56 in 1871. The gross earnings of the road in 1871 were:

From freight	$365,669 80
" passengers	120,129 22
" express, mails, &c.	23,393 97
Total	$419,192 99

The expense of operation during the year, including taxes, insurance, rent of track and car service, was $299,813.39, leaving $119,379.63 for net earnings. These net earnings, the Superintendent says, represent in fact only six months working of the road at its present capacity, the cost of repairs, in other words, of finishing the road after it was turned over by the contractors in February, having absorbed the entire earnings during the next four months. The ratio of expenses to

earnings during the six months from July to December was 54.78 per cent.

The Treasurer's report gives the following general balances:

Capital stock	$4,644,630 00
First mortgage bonds	3,564,000 00
Second mortgage bonds	609,000 00
Bills and accounts payable	408,997 33
Total	$9,226,627 33
Cost of road and equipment prior to 1871	$8,390,845 34
New construction	435,411 70
New rolling stock and machinery	264,186 59
Material on hand	70,359 91
Bills and accounts receivable	58,676 43
Cash	7,147 36
Total	$9,226,627 33

The company had on hand unsold, at the close of the year, bonds issued under the first and second mortgages, to the amount of $452,000.

The cash cost of the twenty-three miles of new road, built by the company during the year, was $17,020.55 per mile. This, the engineer says, was by far the cheapest portion of the whole road, the line running for three-fourths of the way over a level prairie.

New York Stock Exchange.

At a meeting of the Governing Committee, September 25, the following securities were placed upon the free list:

First-mortgage 6 per cent. gold bonds; the second-mortgage 7 per cent. currency bonds, and the stock of the Pacific Railroad of Missouri.

The stock of the Kansas Pacific Railway.

The bonds and stock of the Louisville, Cincinnati & Lexington Railroad Company.

The bonds and stock of the Louisville & Nashville Railroad Company.

The following securities were placed on the regular list:

The 7 per cent. convertible bonds of the Delaware, Lackawanna & Western Railroad Company.

The 7 per cent. consolidated mortgage gold bonds of the Erie Railway Company.

The first-mortgage 7 per cent. gold bonds of the Burlington, Cedar Rapids & Minnesota Railway Company.

The scrip of the Chicago & Alton Railroad Company was placed on the regular call after the stock of the same company.

Cincinnati, Rockport & Southwestern.

In his report to the stockholders, dated September 2, the late President, Mr. Josiah Kirby, says that, sometime ago, he put the 36 miles between Rockport and Jasper, Ind., under contract, confiding in assurances that subscriptions pledged would be made, and that these would be collected in time to meet all obligations. The work was commenced, but subscriptions, especially that of Spencer County, which was depended upon to make early payments, could not be collected when wanted, and therefore the work was done only slowly, and at the date of the report 18 miles, from Rockport north to Lincoln Farm, was to be completed ready for the iron by the 15th of September, and a little work done further north, at an expense of $81,842,-31, or at the rate of about $4,100 per mile. For want of money no contract for iron had been made. Mr. Kirby found some fault with certain preliminary expenses incurred before his administration, and the stockholders, we believe, found fault with Mr. Kirby, and the result was his retirement.

Plymouth, Kankakee & Pacific.

The Hennepin (Ill.) *Record*, of recent date, says:

"The following we learn from good authority: At present there is little doubt but Mr. Barnes, the contractor for ironing the road, has negotiated about $1,000,000 of first-mortgage bonds upon very favorable terms, which will insure the building of at least sixty miles of road this fall and winter, and the sale of the remaining bonds at a very much enhanced value, which will place the speedy completion of the entire railway beyond the possibility of a doubt.

"It is not probable that any work will be done in Putnam County until spring, unless in getting out bridge timbers, ties, etc., but we are assured that the grading in La Salle and Grundy counties, remaining to be done, will be put under contract very shortly.

"We are also informed by the chief engineer that Gen. G. W. Cass has ordered the work on the ten miles he has pledged himself to build to be completed immediately, and that there is a large force already at work on it and the heavy grading on the first ten miles west from Plymouth. All the rest of the work in Indiana is practically ready for the iron."

Erie.

This company has had its new consolidated mortgage bonds, $30,000,000 of which take the place of all previous funded debts, except the sterling bonds for a million pounds placed on the regular list of the New York Stock Exchange. The following official statement concerning them was made:

"Seven per cent. consolidated mortgage bonds, dated September, 1870. Mature September, 1920. Interest payable in gold March 1 and Septemper 1, in the city of New York, or in London, at the option of the holder. Principal and interest payable in gold in New York city or London, at option of holder, $30,000,000.

"Denomination, $1,000 or £200.

"Numbered from 1 to 30,000, inclusive.

"Trustee.—Farmers' Loan and Trust Co.

"The bonds are transferable at the option of the holder, and may be registered or pass by delivery. For the satisfaction and cancellation of the present mortgage debt of $18,554,000, a like amount of these are reserved and remain placed in the hands and actual possession of the Farmers' Loan and Trust Co., of the city of New York, in trust, and to be withdrawn from said trust only upon presentation to, and cancellation by, said Trust Company of an equal amount of said prior lien bonds.

"A further amount of $5,000,000 of bonds under this mortgage, or as many as may be necessary, is intended to be issued to meet the outstanding unsecured sterling bonds, amounting to £1,000,000, as may be agreed upon with the holders thereof."

Delaware, Lackawanna & Western.

The 7 per cent. convertible bonds of this company were placed on the regular list of the New York Stock Exchange last week. The following official account of the loan was given:

"Seven per cent. convertible bonds. Interest payable June 1 and December 1. Principal and interest payable in New York city. Mature June 1, 1892. Denomination, $1,000. Numbered 1 to 3,000 inclusive, $3,000,000.

"Convertible into the stock of the company any time between June 1, 1875, and June 1, 1877. Should the company hereafter execute a mortgage upon the property or franchises, to secure payment of any other of their obligations, this series of bonds shall be included in said mortgage."

Echo & Provo.

A telegram from Salt Lake City says that work is progressing on a railroad 20 miles long from Echo (on the Union Pacific, 39 miles southeast of Ogden) southward toward Provo, being nearly parallel with the Utah Central and Utah Southern.

Louisville, Cincinnati & Lexington.

This company having made application to the Governing Committee of the New York Stock Exchange to have its securities placed on call in the Exchange, submitted the following official statement of its financial condition:

Organized by consolidation of the Louisville & Frankfort Railroad Company and the Lexington & Frankfort Railroad Company, authorized by an act of the Legislature of Kentucky, approved March 2, 1869.

Length of Road.	*Miles.*
From Louisville to Lexington	93.50
From Junction to Newport and Cincinnati Bridge	81.70
Sidings	17.80
Total miles of track	193

Louisville & Frankfort, and Lexington & Frankfort, Cincinnati Branch, joint bonds, dated January 1, 1867. Mature January 1, 1897. Interest 7 per cent., payable January 1 and July 1. Principal and interest payable in New York city	$3,000,000 00
Denomination $1,000. Numbered 1 to 3,000 inclusive. Trustee, Norvin Green.	
Louisville & Frankfort first mortgage 6 per cent. bonds. Mature July 1, 1872, 1873, 1874, 1875, 1876, 1877, 1878. Interest payable January 1 and July 1. Principal payable in New York city	54,000 00
Denomination $1,000. Numbered 1, 2, 60 to 75, 107 to 109, 175 to 182, and 185 to 218. Trustees—James Guthrie, Virgil McKnight, J. B. Bowles.	
Lexington & Frankfort first mortgage bonds interest 6 per cent, payable January 1 and July 1. Mature July 1, 1874. Principal and interest payable in New York city	25,000 00
Denomination $1,000. Numbered 25 to 50 inclusive.	
City of Louisville 6 per cent. bonds, dated January 1, 1850. Mature January 1, 1880. Interest payable January 1 and July 1. Principal and interest payable in Louisville	100,000 00
Louisville, Cincinnati & Lexington second mortgage 8 per cent. bonds. Mature April 1, 1900. Interest April 1 and October 1. Principal and interest payable in New York city	719,000 00
	$3,898,000 00

Preferred stock.—Shares.	$1,000 each.	
Issued	$851,000 00	
Unissued	649,000 00	
		1,500,000 00
Common stock	$50 each.	
Issued	$2,621,137 50	
Unissued	2,345 32	
		2,623,482 82
Total		$3,021,482 82

Officers—President, Norvin Green; Vice-President, Joshua F. Speed; Secretary and Treasurer, R. H. Courtney.

Directors—Joshua F. Speed, J. Guthrie Coke, J. W. Kalfus, J. M. Monohan, R. Ferguson, J. B. Wilder, Louisville, Ky.; M. C. Johnson, James O. Harrison, Henry Bell, E. D. Sayre, Lexington, Ky.; Lyttleton Cooke, E. D. Standiford, Louisville, Ky.

Its securities have been admitted as requested.

Burlington, Cedar Rapids & Minnesota.

This young company, having made application to have its securities placed on call in the Stock Exchange, has submitted the following statement of its condition:

Organized under the general laws of the State of Iowa.

Length of main line—from Burlington, Iowa, to Plymouth	229
Leased road—from Plymouth to Austin	32
Side transfer tracks and branches	17 5-10
From Muscatine to Iowa River	26 5-10
Total	305

First-mortgage 7 per cent. gold bonds, dated May 1, 1869. Mature May 1, 1919. Interest payable May and November 1. Principal payable in New York city or London at the option of the holder	$5,400,000 00
Denomination $1,000 or £200. Numbered 1 to 5,400	
Trustees.—J. Edgar Thomson, Philadelphia; Charles L. Frost, New York City.	
Capital stock, shares $100 each.	
Issued	$4,400,000 00
Unissued	15,600,000 00
	20,000,000 00
Total	$25,400,000 00
Net earnings, from August 1, 1871, to August 1, 1872	450,000 00

Officers.—President, George Greene, Cedar Rapids; Vice President, John F. Ely, Cedar Rapids; Secretary, D. W. C. Rowley, Cedar Rapids.

Directors.—Henry Clews, New York; George Greene, John F. Ely, S. L. Dows, J. W. Tracy, A. S. Bolt, Cedar Rapids; W. W. Waller, New York; James L. Bever, Wm. Greene, D. W. C. Rowley, Cedar Rapids; Fitz Henry Warren, Burlington; J. W. Barnes, J. W. Barhydt.

Hastings & Dakota.

A surveying party has commenced locating the line west from Glencoe, and it is intended to have the permanent location made, for some 60 miles west of that point, this fall.

Pine River Valley.

A company has been formed to build a railroad from a point on the Prairie du Chien Division of the Milwaukee & St. Paul road, near the mouth of the Pine River, and about 145 miles from Milwaukee, north through Richland Center and Hillsboro to Union Center, a distance of about 30 miles.

Port Huron Ferry.

The iron ferry-boat "International" commenced making regular trips between Port Huron and Sarnia September 18. She carries 20 freight cars at once, without difficulty.

Ashtabula, Youngstown & Pittsburgh.

The track is laid to Bloomfield, Ohio, about 13 miles from New Lyme, the late terminus, and 20 miles from Ashtabula.

Columbus & Toledo.

Center township, in Wood County, Ohio, has voted $19,000 to this road.

Shenandoah Valley.

The Clarke County (Va.) *Courier*, of September 26, publishes a statement from an officer of the company, in which the following statements are made:

"Allow me to say, in conclusion, that, so far as I know, there is no trouble with the Shenandoah Valley Railroad. The graduation upon nearly sixty miles has been completed. Nearly one-half the debt for right of way through Jefferson, Clarke and Warren counties has been discharged, and all this without the hypothecation or sale of but $10,000 of Jefferson County bonds. There has been no sale of the Clarke County bonds, and, as yet, there is no mortgage nor incumbrance of any kind upon the road-bed or franchises of the company.

St. Louis & Iron Mountain.

In a letter from Mr. S. Frink, General Freight Agent of this company, published in the St. Louis *Republican* of September 28, we find some statements as to the preparations of the company for next winter's Southern trade. The company has made large additions to its stock of cars during the summer, and has still 150 cars under contract, to be delivered this fall. It has now 450 cars in the "Green Line" and will have its full quota, 500 cars, in that line this fall. A number of new locomotives have been purchased and more are under contract. A new depot building is being put up in St. Louis, which will afford additional loading room, equivalent to 750 feet of front. To provide for river business south from Belmont, large additions are being made to the elevator at that place, giving it a capacity of at least 300 tons each way daily.

Long Island.

The grading for the extension of the Northport Branch, from Northport to Stony Brook and Port Jefferson, has been completed, and the track-layers are at work. It is expected that the road will be finished by November 1. It is about 17 miles long.

La Crosse Bridge.

In view of the probable location of the Milwaukee & St. Paul Railway bridge at La Crosse some miles above the town, the citizens have taken steps to form a company with a capital of $300,000, to build a railroad and highway bridge directly opposite the town. The name of the company is to be the La Crosse & Minnesota Bridge Company.

New Orleans, Baton Rouge & Vicksburg.

This company has recorded a mortgage of $12,000,000 in favor of the Union Trust Company of New York.

Marquette, Houghton & Ontonagon.

The Marquette (Mich.) *Mining Journal* says that Superintendent Merritt has gone east for the purpose of ordering nine new locomotives, seven for the company and one each for the Cleveland and the Lake Superior mining companies. The business of the company is increasing very rapidly.

Brownsville & Nodaway Valley.

This road is completed from Villisca, Iowa, on the Burlington & Missouri River Railroad, 225 miles west of Burlington, to Clarinda, in Page County. Clarinda is 15 miles from Villisca and nearly due south from that town.

Hannibal & St. Joseph.

The new road to Atchison is nearly completed, and it is expected that the work will be finished and cars running from Hannibal to Atchison by November 1.

East Broad Top.

The contract for the grading of this road from Mount Union, Pa., on the Pennsylvania Railroad, 191 miles west of Philadelphia, south about ten miles to Orbisonia, has been let to Rowland Jones & Co., of Tamaqua, Pa., the work to be finished by March 1, 1873. Engineers are now at work completing the survey of the line to Broad Top City, preparatory to putting it under contract this fall.

Baltimore, Pittsburgh & Chicago.

Mr. James L. Randolph, Chief-Engineer of the Baltimore & Ohio Railroad, advertised for proposals to be made at Tiffin, O., or Camden Station, Baltimore, by October 1, for the graduation and masonry of the Ohio Division, Baltimore, Pittsburgh & Chicago Railroad, extending from the Lake Erie Division of the Baltimore & Ohio, near Havana, O., westward to the crossing of the Toledo, Wabash & Western, in Defiance, O., about 120 miles.

East St. Louis, Cahokia & Falling Springs.

This road is now completed and was formally opened September 26. The road runs from East St. Louis south to Cahokia, whence the main line turns to the southeast and runs to the village of Falling Springs. From Cahokia a branch runs west to the Mississippi River, opposite Carondelet. The whole length of the road is 11½ miles.

Milwaukee & St. Paul.

The Winona (Minn.) *Republican* reports that work is to be commenced at once on the extension of the Iowa & Dakota Division from Algona west to a junction with the St. Paul & Sioux City road in O'Brien County, Iowa. This extension would be about 80 miles long.

Iowa Central.

Work was commenced between Northwood, Iowa, and Albert Lea, Minn., on the extension of the road to Albert Lea. The distance is about 12 miles, and it is expected that the road will be completed by November 1.

St. Louis & Keokuk.

Track has been laid from Hannibal, Mo., south to New London, about nine miles, and sufficient iron is on hand to extend it to Frankfort, about six miles further. The entire road south into St. Charles County is under contract, and the work is being pushed forward as fast as possible.

Quincy, Missouri & Pacific.

The Quincy, Ill., *Whig*, of September 28, says that this company has succeeded in placing its bonds to the amount of $5,500,000 in London, at satisfactory rates. Work on the road is to be pushed forward.

The company has made arrangements for laying track this fall on three miles at the western terminus, between the Missouri River opposite Brownsville and Phelps, a station on the Kansas City, Council Bluffs & St. Joseph Railroad. This will make Brownsville accessible during the winter.

Castle Shannon

This narrow-gauge railroad, which is intended to run from Pittsburgh south to Castle Shannon, is nearly completed. The road is nearly all ready for the ties, and the iron is laid for some distance beyond the bridge over Knox's Hollow, about three miles from the city. The bridge work is almost all finished, and it is expected that trains can be run over the whole length of the road by October 15. A large coal traffic now passes over the finished portion of the road from the company's mines to their coal depot in Pittsburgh, over 400 car-loads being hauled daily. The company has four locomotives and a number of passenger and freight cars. It is expected that a large suburban traffic will pass over the road, which is to be shortly extended to Findleyville, in Washington County, some 16 miles from Pittsburgh.

New Suspension Bridge over Niagara River.

A company has been formed in Canada to construct a suspension bridge over the Niagara at Queenston for the use of the Lake Ontario Shore and other railroads.

Northern, of Canada.

The report of this company for the half-year ending June 30, 1872, gives the gross earnings as $390,271.03, as against $365,441.76 for the same period last year, being an increase of $24,829.27, or 6¾ per cent. The ordinary working expenses were $238,364.79, or about 61 per cent. of the gross receipts, and the outlay on "works of extension" was $63,164.50, leaving the net earnings $88,741.74. The lines of the Northern Extension are in rapid progress. On the line from Barrie to Orillia, 22 miles are in operation and the earnings are satisfactory. A further length of the Muskoka Branch to the village of Atherly was to be opened September 15. On the North Grey Branch, 12½ miles, to Thornbury, were opened September 2. The trade of the main line was embarrassed by the late opening of lake navigation and the insufficient supply of lake craft and the consequent difficulty of getting rid of freight at the terminus; but in spite of these obstacles the traffic has shown a very satisfactory increase. Serious damage was done to the breakwater at Collingwood last winter, but the Dominion Government has made a conditional grant of $35,000 for its restoration, and negotiations are now in progress to secure the completion of the repairs under the conditions made by the Government. The main line of this company runs from Toronto to Collingwood, on Georgian Bay, a distance of 95 miles, and much of its traffic is in lumber.